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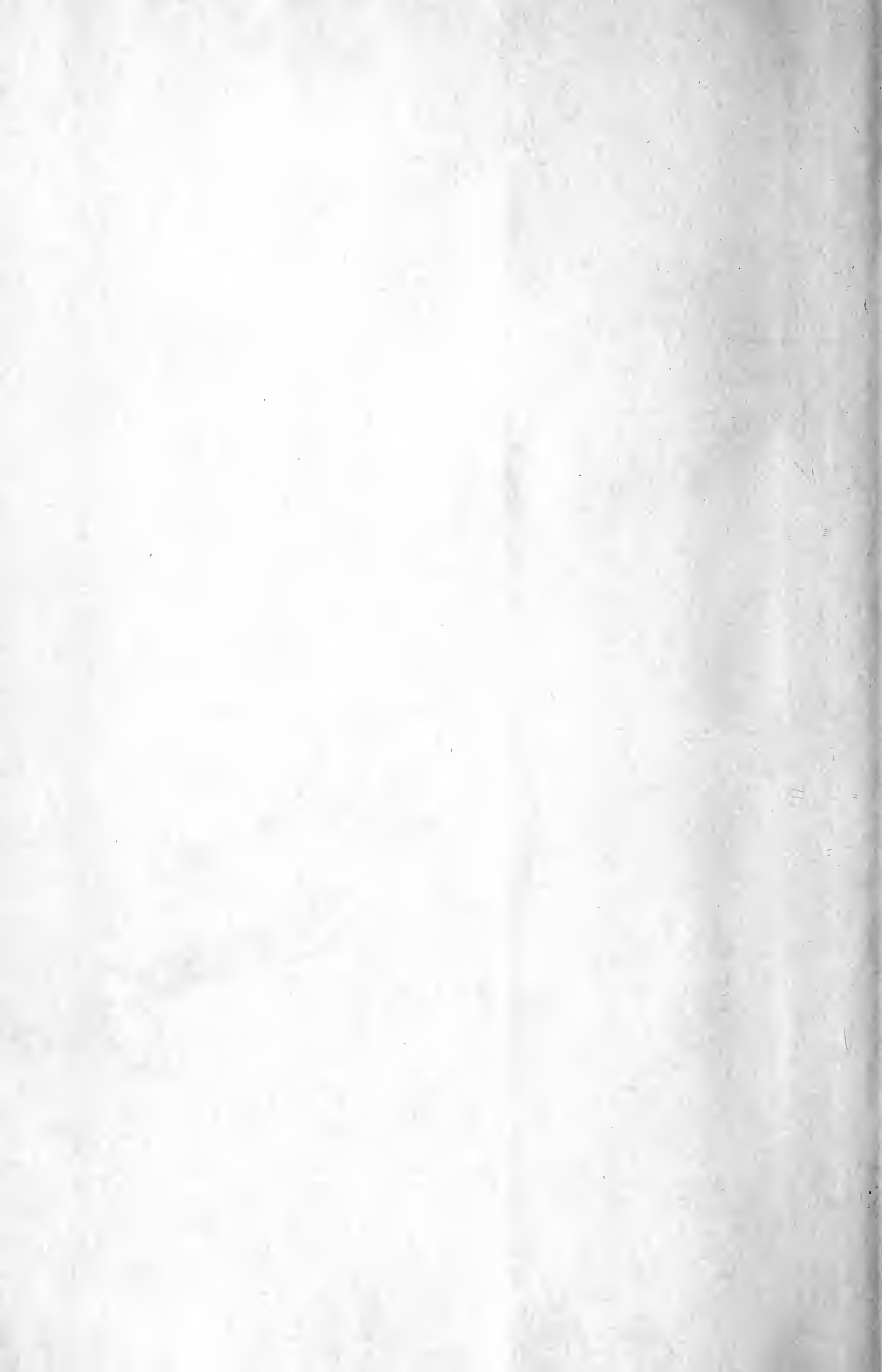
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III

STUDIES IN
THE BORAGINACEAE, IX

1

THE ALLOCARYA SECTION OF PLAGIOBOTHRYDS
IN THE WESTERN UNITED STATES

2

NOTES ON VARIOUS BORAGES OF THE
WESTERN UNITED STATES

BY

IVAN M. JOHNSTON



PUBLISHED BY
THE ARNOLD ARBORETUM OF HARVARD UNIVERSITY
JAMAICA PLAIN, MASS., U.S.A.

1932

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I. THE ALLOCARYA SECTION OF PLAGIOBOTHRYS IN THE WESTERN UNITED STATES

INTRODUCTION

THE INVITATION to contribute the accounts of the *Boraginaceae* for several western floras now in preparation redirected my attention upon certain difficult groups of western borages which previously I had not studied in detail. One of the most perplexing of these has been the section *Allocarya* of the genus *Plagiobothrys*. This group, the subject of the present paper, has received my full attention for a number of months. I have found the problems it presents in classification the most difficult I have yet encountered in my various studies in the *Boraginaceae*.

Allocarya is a youthful group in which the evolutionary products have not yet been well shaped by time and environment. It presents bewildering individual variation, a wealth of transitional forms, and general lack of evident specific lines. In short it is one of those extremely involved groups which, in the interest of the taxonomist's patience and good humor, might well be left as a subject for genetics did not the taxonomist in his stubbornness and the exigencies of flora-writing insist that it must be classified. Obviously the taxonomic study of such a variable group must, of necessity, reflect the judgment of the investigator. It seems well, therefore, to state the two principles which I have used in shaping the classification which I here present.

In the first place I believe that within a group of related genera the units of classification should be kept more or less uniform in value and that "splitting" or "lumping" should be relatively consistent throughout. This is not only quite logical but in addition is also of practical moment since phyto-geography, floristics and other subjects which find their data in taxonomics must have comparable units in order to make their findings significant. In the second place I believe that climatic and geographic features in western United States, with their attendant stimulus for change and opportunities for iso-

lation and speciation, have so shaped evolution in the youthful and characteristic groups there, that facts of distribution can be offered as tests of the naturalness of a proposed species. As there is no reason for believing that *Allocarya* has had special opportunities for dispersal I have assumed that it is responding to the various influences in the same general manner observable in other youthful groups occupying the same area. Among the various possible species that are definable in *Allocarya* those with a distribution most in harmony with the distributional behavior of other groups in the same area have of a consequence been considered as most likely natural. Through the guidance of these two principles I believe a classification of *Allocarya* has been obtained which is credible and practicable and which also conforms to and indicates the major evolutionary products within the group.

When Gray closed his work on the American borages in 1885 the collections of *Allocarya* available to him were too few for him to have any conception of the complexity of the group. The real condition seems to have been first realized by Greene, then resident in California, whose interest in the borages had led him to observe *Allocarya* closely in the field. Greene, *Pittonia* 1:12-20 (1887), proposed the genus *Allocarya* and gave the first reasonably adequate account of its species. Eighteen species were recognized from western United States, about double the number treated by Gray. The next serious study of the group was by Piper, *Contr. U. S. Nat. Herb.* 22:79-113, whose "Study of *Allocarya*" appeared in 1920. A total of 79 species were treated, the majority of which were newly proposed. In 1923, I published "A synopsis and redefinition of *Plagiobothrys*" (*Contr. Gray Herb.* 68:57-80). The characters of the genus *Allocarya* were discussed and reasons were given for reducing it to a section of *Plagiobothrys*. Piper's exuberance in species-making was criticized and only 18 species were recognized from western United States. A key, which later tests proved unsuccessful, was also provided. The next important work on the group, a treatment of the numerous Californian species, was by Jepson, *Man. Fl. Pl. Calif.* 850-854 (1925). The genus *Allocarya* was maintained by him and a total of 21 species was recognized. By lack of any mention, many of Piper's species were tacitly reduced. The

latest work on the present group is that by Brand, in Engler, Pflanzenr. iv-252² (Heft 97):25-28, 104-105 and 159-182 (1931). Piper's species were all recognized and some newly proposed ones added. As a treatment of the group for the World Brand's work is inexcusably uneven, the North American species being split excessively whereas the South American species are lumped most drastically. The genus *Allocarya* was recognized for most species, though two groups of Californian forms were segregated by Brand to form the genera *Echinoglochin* and *Glyptocaryopsis*.

THE STATUS OF ALLOCARYA

During the period since 1923 when I first argued for the reduction of *Allocarya* to a section under *Plagiobothrys* I have become increasingly convinced of the logic and practicability of that reduction. That *Allocarya* is most closely related to *Plagiobothrys* has been admitted by most authors. As it is very much more closely related to *Plagiobothrys* than that genus is to any other, its recognition merely lowers generic values and standards, logically introduces further generic segregation of *Plagiobothrys*, eventually of such genera as *Cryptantha*, and so threatens these well marked and distinctive groups. With *Plagiobothrys* and *Cryptantha* defined broadly the American borage genera are capable of very precise definition. All attempts to segregate merely makes generic definition more difficult and less precise. Specific classification in the American borages is sufficiently difficult through the technicality and inconstancy of characters to make me feel that precision and practicability in generic characters are objects well worthy of such sacrifice as the submergence of *Allocarya* may entail.

In 1927 Macbride published "A defense of *Allocarya*" (Pub. Field Mus. Nat. Hist., Bot. 4:119-122) as a reply to the arguments for the reduction of *Allocarya* published by me in 1923. This "defense" represents the first serious attempt to justify the recognition of *Allocarya*, the previous attempts consisting of merely vague mutterings concerning "habit," "opposite leaves" and "basal and suprabasal nutlet-attachments." As it comes from the pen of one well informed on the

intricacies of the American borages it clearly merits detailed consideration.

Macbride, l. c. 120, first reaffirms that *Allocarya* has a distinct habit, arguing that "there surely is a certain facies, *even though undescribable*, about *Allocarya* and *Plagiobothrys* (including *Sonnea* and *Echidiocarya*) for which a student soon acquires a feeling eliminating a sense of confusion between the two genera, *at least as regards most species, that possibly may have existed in his mind*" (the italics are mine). With this I am inclined to agree. But is this intangible something in habit in *Allocarya* more significant than that something else in habit which causes me to see resemblances between various species or groups of species within *Plagiobothrys* or even within *Allocarya* itself? Personally I do not believe it is. In any case we are able to dismiss such subjective considerations, for Macbride has admitted in the above quotation that habit in *Allocarya* sometimes approaches that found in *Plagiobothrys*. That he has abandoned the use of "habit" as a serious argument for *Allocarya* is implied in the following,—“Even in the case of *A. mollis*, for instance, which as Johnston remarks ‘is in gross aspect strikingly like southern forms of *P. canescens*,’ the nutlet characters that serve with reasonable reliability to distinguish the two genera are diagnostically developed. And so with the other *Allocaryas* that simulate species of *Plagiobothrys*.” Macbride, therefore, has admitted my first contention. Gross habit will not serve to distinguish the two genera. That so much stress has been placed on habit in this genus merely indicates how weak are its claims for recognition. Intangible qualities of habit are seldom mentioned when decisive characters for generic distinction are to be found in structures of flower or fruit.

Following his discussion of habit Macbride continues,—“Anyway the easily debatable question of aspect is trivial when used as an argument pro or con in drawing generic lines. Accordingly Johnston seeks more tangible evidence in support of his contentions, and apparently finds it in the discovery that *P. fulvus* and *A. Greenei* have nutlets with ‘similarly placed, very similar excavated scars’ that possess as well ‘a remarkable agreement in size and shape . . . and in the arrangement of keels and ridges upon them.’ Furthermore lower opposite

leaves, regarded as a character peculiar to *Allocarya*, are found to exist in at least two species that in other respect might be referred to *Plagiobothrys* and the character itself is shown to be quantitative in its development. Therefore the recognition of *Allocarya* must obviously depend upon a redefinition and somewhat different analysis of those characters that have heretofore been regarded as salient."

"These may be expressed and contrasted as follows:

- "Nutlets strongly incurved (in greater or less degree) and with a lateral medial or nearly medial or excavated scar of attachment, or this rarely raised on an obscurely or prominently developed stipe; leaves in most species all alternate or if not the nutlet characters pronounced*Plagiobothrys*.
 "Nutlets erect and with basal scar (this rarely stipitate), or somewhat incurved and scar lateral and sometimes excavated, but then clearly suprabasal or nearly basal rather than submedial; lower leaves always opposite.....*Allocarya*."

Macbride evidently admits that the past use of opposite-leaves as a crucial generic character of *Allocarya* is impracticable. The development of opposite leaves in *Allocarya* is indeed quantitatively variable within the genus, there being numerous pairs in *A. mollis* while in other species only one or two of the lower pairs of leaves are opposite. What is more, the Australian *A. plurisepala* Brand, and the Patagonian *A. alternifolia* Brand, appear to be good *Allocaryas* in habit and fruit and yet appear to have no opposite leaves developed. Even Brand, who defines *Allocarya* much more narrowly than Macbride, saw no reason for removing them from that genus.

A study of seedlings or slender spindly plants grown in grass or shade will show that opposite leaves are developed by most if not all species of *Amsinckia* and *Cryptantha*. Next to *Allocarya* these genera are the closest relatives of *Plagiobothrys*. These genera together form a compact natural group and there is every indication that they are closely interrelated. Since all of them, except *Plagiobothrys*, have evident opposite leaves, and particularly since *Allocarya* seems to have been derived from *Plagiobothrys*, there is a strong reason for believing that even true *Plagiobothrys* also has morphologically opposite leaves and has them masked in the rather dense basal foliar rosette. In *Echidiocarya*, which Greene and Macbride

agree with me in placing as a section under *Plagiobothrys*, there are evident pairs of opposite leaves frequently developed. Truly no crucial character for *Allocarya* is to be found in the opposite leaves developed by species of that genus.

Having disposed of the supposed generic characters found in the habit and leaf-arrangement of *Allocarya* we can now turn to a consideration of the characters of fruit. Macbride has apparently considered these as the most important. A study of his confusingly involved key which I have quoted above will show that Macbride really wishes to separate *Allocarya* from *Plagiobothrys* by the position of the attachment scar on the nutlet, placing in *Allocarya* those plants with attachment lower than inframedial, and in *Plagiobothrys* those in which the attachment is on a lateral stipe (§ *Echidiocarya*) or is sessile with an inframedial, medial or supramedial position on the nutlet. In its stand on these characters *Allocarya* is pushed back to its last and strongest position. In recent years I have become convinced that the claims of this genus for recognition must stand or fall on these grounds.

When one comes to an accurate statement of the fundamental differences between *Allocarya* and the two sections (*Euplagiobothrys* and *Sonnea*) of *Plagiobothrys* most related to it, the essential weakness of *Allocarya* becomes apparent. The differences are as follows:

Plant frequenting mostly wet soils; with few exceptions having at least some of the lowermost leaves opposite; nutlets ovate to lanceolate, incurved or straight or somewhat outcurved, attached ventrally and distinctly suprabasally or obliquely on the venter near the base or distinctly basally*Allocarya*.

Plant frequenting well drained soils; lowermost leaves usually crowded and in a rosette, at least not evidently opposite; nutlets ovate, incurved, attached supramedially, medially or inframedially on the venter; § *Euplagiobothrys* and § *Sonnea* of*Plagiobothrys*.

From this contrast it will be seen that no character is a sharp decisive one. While most *Allocaryas* frequent heavy wet soils, some grow on grassy slopes and fields in soils as elevated and as well drained as those frequented by the common spring-flowering species of *Plagiobothrys*. Some true *Allocaryas* do not have opposite leaves. There is a distinct possibility that morphologically opposite leaves are present and

obscured in the crowded basal rosette of true *Plagiobothrys*. In any case indisputably opposite leaves are frequently present in *Plagiobothrys* § *Echidiocarya*. In shape and in the degree and kind of curving of the nutlet there is a complete transition between *Allocarya* and *Plagiobothrys*. The suprabasal and basal nutlet attachment of *Allocarya* are merely extremes of a tendency to shift attachments that is well developed in *Plagiobothrys*. What is more, if the major emphasis is to be placed on this difference of attachment-position on the nutlet it is well to recognize the practical difficulties in precisely stating such quantitative characters. The difference between "infra-medial" and "suprabasal" at times resolves into scarcely more than mere words.

The characters separating *Allocarya* from *Plagiobothrys* have their weakness thrown into still greater relief by a comparison of them with the distinct fundamental morphological characters that set off *Plagiobothrys* from other closely related genera. *Amsinckia* differs from *Plagiobothrys* in the shape and color of corolla and in the unique 2-cleft cotyledons. *Cryptantha* (including *Oreocarya*) is separated by a very different type of nutlet-attachment, this being along an elongate slit in the pericarp rather than through a scar-like structure borne on it. These differences are morphological and absolute, not quantitative. *Allocarya* is very much more closely related to *Plagiobothrys* than that genus is to any other of the distinctive West American genera. As its characters are not absolute and its relations are obvious I believe it had best be treated as a section of *Plagiobothrys*. If it is not reduced to *Plagiobothrys* then the splitting of that genus into several ill defined segregate genera becomes logical and generic splitting of *Cryptantha* and even *Amsinckia* would naturally follow. Facing this alternative I can only repeat that as there is enough trouble to be found in the classification of the species of this family I necessarily feel that students can well be spared any additional trouble in the fretting over small ill defined genera. The large genera *Plagiobothrys*, *Cryptantha* and *Amsinckia* are thoroughly natural and capable of exact delimitation. I feel they should remain so.

Having considered Macbride's case for *Allocarya*, we may now concern ourselves with the recent comments by Brand, in

Engler, Pflanzenr. iv-252² (Heft 97):17 (1931). This monographer admitting that good grounds can be adduced for, as well as against, the reduction of *Allocarya* proceeds to make the unqualified statement that in *Plagiobothrys* the nutlet-attachment is "central" and that in true *Allocarya* it is "basal." While admitting that there are connecting links between the two genera he quotes an enunciation of Graebner to the effect that if one does not wish to come to failure in systematic work one must proceed as if transitional forms are completely absent and upon this basis Brand proceeds to maintain *Allocarya*. This at least is a frank admission that *Allocarya* does intergrade with *Plagiobothrys* and that there are no decisive characters to separate it from that genus. The claims of *Allocarya* for recognition have been reduced to that of mere expediency.

It is on the grounds of expediency, however, that I feel some of the strongest arguments can be presented for the reduction of *Allocarya*. For unless we take advantage of the marked morphological differences presented and define *Plagiobothrys*, *Cryptantha* and *Amsinckia* naturally and broadly we must face the alternative of a great array of ill defined arbitrarily dis-severed genera. Brand's recent treatment of the Pflanzenreich is an example. He breaks up *Allocarya* into three genera and *Plagiobothrys* into the same number. Reducing his generic key to the pertinent items these segregate genera are revealed distinguished as follows,

Gynobasis elevationibus ornatus [*Allocarya hystriacula*,
acanthocarpa, *oligochaeta*, *echinacea*, *Austinae*,
cristata, *Eastwoodae*, *Greenei*].....4. *Echinoglochin*.

Gynobasis excavationibus ornata.

Nuculae stipite funiculum simulante lineari vel breviter
 vermiformi ad gynobasin affixae [*Plagiobothrys*
californicus et spp. affines].....15. *Allocaryastrum*.

Nuculae cicatrice ad gynobasin affixae.

Cicatrix magna dimidiam partem nuculae aequans
 vel superans [*Allocarya glyptocarpa*, *spiculifera*,
anaglyptica, *papillata*, *microcarpa*].....18. *Glyptocaryopsis*.

Cicatrix parva nuculis multo minora.

Cicatrix centralis, raro supracentralis [*Plag.* §
Amsinckiopsis, § *Euplagiobothrys*, § *Sonnea*]

.....19. *Plagiobothrys*.

Cicatrix basalis.

Nuculae bene coalitae [no mention of the long
 stipe of nutlet; *Plag. Pringlei*].....25. *Echidiocarya*.

Nuculae omnes liberae26. *Allocarya*.

I feel that all this array of genera should fall into the synonymy of *Plagiobothrys*; *Echinoglochis* and *Glyptocaryopsis* going into § *Allocarya*, and *Allocaryastrum* and *Echidiocarya* falling into the § *Echidiocarya*. To recognize these segregate genera would logically force me to find further genera in *Plagiobothrys* sections *Sonnea* and *Amsinckiopsis*.

Among the genera listed we need to discuss at this time only *Echinoglochis* and *Glyptocaryopsis*. These coincide exactly with the specific groups, *Echinaceae* and *Glyptocarphae* of Piper. As genera they seem pitifully poor indeed. Of *Echinoglochis* Brand lists eight species, of these he admits having seen only a single specimen each of *E. echinacea* (*Allocarya echinacea*) and *E. Greenei* (*A. Greenei*). Concerning the former species he remarks that "Bei dieser Art neigt die Gynobasis zur Depravation. Infolgedessen ist der Gattungscharakter oft kaum zu erkennen." Concerning his specimen of *A. Greenei* he says, "Das Specimen 'Hansen n. 1610' zeigt die eigenartige Gestalt der Gynobasis in vollster Deutlichkeit." Of the six species he places under *Glyptocaryopsis* he has apparently seen only a specimen each of *G. glyptocarpha*, *G. spiculifera* and *G. microcarpha*. Brand's new genera, consequently, were based on ridiculously inadequate material and what is more upon material that is partially contradictory. The elevations on the gynobase which justify his genus *Echinoglochis* are associated with the excavated scar. Close examination will also discover this same very striking character in his *Glyptocaryopsis* and, what is more, in *Plagiobothrys fulvus*, the genotype of *Plagiobothrys*. No character in *Allocarya* shows more complete transition than this character of excavated scar and associated phenomenon of elevation on the gynobase. Excavated scars and flat or convex ones are to be found and every degree of transition between them, and along with them the corresponding transitions in the gynobase. Piper distinguished his two groups by the presence or absence of barbed appendages, and this, in fact, is the only difference between the two genera based upon them. As there is every evidence that the species of the San Joaquin Valley of California may have in a single colony nutlets that vary from strongly appendaged and barbed through merely papillate and unarmed to simply rugose, it is evident that Brand's genera may be additionally con-

demned as quite unnatural. In finally disposing of them I can only add that they stand preeminent as the weakest and most unsupportable genera yet proposed for the American *Boraginaceae*.

Brand's small weak segregate genera, however, are merely indications of what logically must follow in the future if the large natural genera such as *Plagiobothrys* and *Cryptantha*, based upon profound morphological differences, are abandoned in favor of weak habit-genera based upon fluctuating qualitative characters. *Allocarya* may well be sacrificed if for no other reason than in the interest of a consistent, clear, natural, morphologically-based generic classification of our West American borages.

The argument might be advanced in favor of *Allocarya* that because of its nearly universal acceptance since it was first proposed in 1887, the repeated use of the name has given it a certain claim for recognition. In reply to this it is to be pointed out that though recognized generally in floras this was done blindly. Since Greene's original studies in 1887 there is no evidence that the generic characters and relations of *Allocarya* were closely studied until my paper in 1923. Until that time no one had gotten even sufficiently into the problem to discover the very evident fact that the opposite leaves of *Allocarya* are not unique among American borages, and that this character is not at all diagnostic of *Allocarya*. Usage so persistently uncritical as that shown in the bibliographic history of *Allocarya* should certainly form no serious basis for argument.

I have indicated various reasons why *Allocarya* had best be treated as only a section of *Plagiobothrys*. For those who are unable to accept my arguments and for those who admitting them still nevertheless wish to retain the group as a genus chiefly because the name has become a familiar one, I must point out that *Allocarya* is no longer legally tenable as a generic name. *Allocarya* Greene (1887) is much antedated by *Maccoya* F. v. Muell. (1859). What is more, until we have an official pronouncement, there is always a chance that *Antiphytum* Meisn. (1840) will be reinterpreted and brought forth as a still earlier name.

While I am satisfied that *Antiphytum* has been sufficiently centered by tradition on certain Brazilian and apparently in-

separable Mexican species to have its application logically restricted to them, cf. Contr. Gray Herb. 68:48-52 (1923) and l. c. 78:11-14 (1927), I must admit that arguments can be presented by which the use of *Antiphytum* in the sense of *Allocarya* could be justified. Brand, Fedde, Rep. Spec. Nov. 27:145-149 (1929), has discarded *Antiphytum* as a *nomen confusum*. I have been informed that he was partially motivated in this by the feeling that otherwise the name would have to be applied to *Allocarya*.

The case for *Maccoya* is clear. Brand in the Pflanzenreich, iv-252² (Heft 97):159 (1931), has admitted it as a synonym of *Allocarya* but rejects it as a "nomen antiquissimum, sed formae anomalae inditum." He treats, however, *Allocarya plurisepala*, the genotype of *Maccoya*, as a good species, l. c. 165. Significant also is the fact that during a visit at his home in Sorau in 1927 I was shown Koch's collection from Mt. Lyndhurst, as merely an interesting new species of *Allocarya*. As subsequently shown by me, Contr. Gray Herb. 81:75-78 (1928), this specimen proves to represent *Maccoya plurisepala*. That species is peculiar only in the instability of the number of its floral parts. This variation fluctuates around and includes the number usually prevailing in *Allocarya*. As the plant has a distinct range, with the inconstancy in number of its floral parts evident in all parts of its range, I see no reason for not considering the plant as normal. It is so accepted by Australian botanists who know it in the field, cf. Black, Fl. So. Austral. 695 (1929) and Ewart, Fl. Victoria 969 (1930).

THE SPECIES OF ALLOCARYA

Having considered the relations of *Allocarya* as a group we may now turn to a discussion of the problems presented by its species. Piper has approached this problem of species as one chiefly of analysis. He has described every variation found and as the fruit showed remarkable diversity produced a classification largely founded on minutiae of nutlet-sculpturing. By laboriously breaking up the arc of variation into small segments he obtained a very great many species-concepts and these just as small as the power of his microscope, the number of his specimens, and his time and patience permitted. Piper

justifies these results on the grounds of precision in identification. I feel however that such precision as he has achieved is only through breaking the sweep of variation into small bands arbitrarily defined, and that his definiteness is largely one of definition. My study of *Allocarya* has given me every reason to believe that the small pigeon-holes he so painstakingly elaborated can be endlessly further divided and multiplied towards a figure limited only by the number of individuals. It seems to me that, in failing to seek for the evolutionary plan within the group and in losing sight of practicability, Piper has presented a classification whose limiting factors are largely material and physical exhaustion. In addition it is flagrantly artificial.

The very number of new species proposed by Piper arouses suspicion. The increase is entirely disproportionate to that observed in other groups of the western flora. When Gray closed his studies of the borages in 1885 only 10 species of *Allocarya* had been proposed from western United States and adjacent Canada. At the close of 1902 a total of 25 additional new species had been added from the same region, with Greene standing responsible for all but 4 of this increase. The next additions for the region came eighteen years later in 1920 when Piper published his monograph and proposed no less than 48 new species. Subsequently Piper and Brand have published 13 more. There has been nearly a 200% increase in the number of proposed species since 1919. This is most surprising indeed when it is realized that most of the species published in this period belong to one of the most thoroughly studied floras in the West, that of California, and, what is more, to the very flora in which *Allocarya* has already received the close study of that prolific student of the borages and sponsor of fine segregates, E. L. Greene.

The reception met by Piper's many new species has been rather varied. Clute, Amer. Bot. 26:65-6 (1920) and l. c. 28:176 (1922), considered them the occasion for facetious remarks. In my synopsis of the group in 1923 I recognized only 2 of them. Though over 30 of Piper's species were typified on material from California only 11 of them are given any recognition in Jepson's recent Flora (1925) of that state and what is more 6 of these are treated as varieties only. Brand

(1931) recognized all of Piper's species, provisionally. In the present paper I have recognized 9 of Piper's proposals.

Brand's comments, in the *Pflanzenreich*, iv-252² (Heft 97):18 (1931), on Piper's species and his reasons for recognizing them are most interesting. We are told that though at first he thought that Piper's species might have only microscopic basis that examination of material (representing less than half of these new species) convinced him that Piper's characters do exist and that they are often accompanied by differences in habit. Whether, however, the characters are constant and indicate "species" or whether, more likely, they indicate only varieties, forms and hybrids that is a problem to be settled by garden studies. Until this is done Brand felt that Piper's detailed work should be recognized. Consequently he maintained all the proposed new species as "species" provisionally. He even proposed some similar new species of his own. Brand's attitude towards Piper's segregates, therefore, obviously resolves itself into a mere conditional acceptance without endorsement.

The great increase in species-making in *Allocarya* that began with Piper's monograph has been based upon the conviction that all roughenings and outgrowths observed on the nutlets were constant or at least only slightly variable. That there is great variation in the distribution and abundance and character of the warts, ridges and appendages found on the nutlets of various forms of *Allocarya* is not to be doubted. I believe there are many reasons to doubt, however, that they are as constant as Piper would have us believe. Furthermore, I am of the opinion that if Piper had studied *Allocarya* in the field and there observed the nutlet variations, he would have proposed considerably fewer species. Field studies would have made it clear that even in small colonies bordering ditches or low ground, or even more strikingly in those flourishing in the small scattered depressions on plains and mesas, there can exist remarkable variation in nutlets among plants which otherwise certainly seem to constitute a uniform population. As those differences which Piper has dignified as specific can occur among plants which close scrutiny prove to be otherwise inseparable, and as various of his species may be found in a handful pulled at random from among the dense growth of *Allocarya*

covering the bed of a single small vernal pool, I believe that many of the Piperian nutlet differentiae represent merely individual variation.

In dignifying the sundry nutlet variation observable in these sociable forms as species, Piper would have us believe that members of a close group of interrelated species can occur erratically practically throughout the area of dispersal of the group as a whole and even actually grow intermixed. Experience has shown, however, that with normal fertilization, of which there certainly seems every evidence in *Allocarya*, the tendencies for speciation within a group can not reach a full expression when there are such excellent opportunities for cross-fertilization between its conservative and possibly deviating forms. We are accustomed to find the immediate relatives of a species not growing with it but off rather in an area neither adjacent or even far removed. This is the behavior of the species in the other genera which grow with these various forms of *Allocarya*, and certainly that in such genera as *Pogogyne*, *Navarretia*, *Downingia*, etc., which similarly tend to select vernal pools as habitats. My studies have shown that there are practicable species in *Allocarya* which also behave in this familiar manner. It is highly significant, however, that such concepts can be defined only if many of the minute differences of nutlets, which Piper has insisted are specific, are discounted as mere individual variations.

My approach to the study of the species in *Allocarya* has been determined by a belief that the same climatic, edaphic and biotic factors which have stimulated evolution and permitted speciation in other characteristic West American groups would have influenced *Allocarya* also. My object has been to find morphological traits which characterize practicable species having geographic ranges comparable to those observable in the species of other groups subjected to the same environmental influences. Achieving this and finding that most of them were further characterized by intangibles of habit which permitted them to be recognized from aspect alone, I have considered them to be eminently natural. While it has been impossible to define many of the species sharply the regional occurrence of the transitional forms has been such as in no way to cast doubt on the naturalness of the species. It will be

found that transition between species is mostly localized in those areas in which distributional barriers are weak and more or less ineffectual and in exactly those areas in which a similar hybridization and intergradation is observable in other groups.

The principal basis for my study of *Allocarya* has been the material in the Gray Herbarium (G). This large and representative collection has been worked over repeatedly and with the greatest of patience and detail. All of the material in it has been cited. I have also visited and studied in the herbaria of the New York Botanical Garden (NY), United States National Herbarium (US), Notre Dame University (ND), Willamette University (Salem), Oregon State College (Corv), University of Oregon (Eug), University of California (UC), California Academy of Sciences (CAc), Stanford University (Stan), and Pomona College. From these institutions I have cited only authentic, rare or otherwise significant specimens. I am greatly indebted to all those who are in charge of the above mentioned herbaria. Without the many facilities for study which they most kindly provided this paper must have remained untested and incomplete.

The publication of this paper is not accompanied with a loss of interest in *Allocarya*. There remains yet to be written in the next few years an account of the genus for a flora of the Pacific Coast and a few years later one for a flora of North America. I am accordingly most anxious to receive any criticism and information which may help me improve on the classification of *Allocarya* here proposed. I am particularly anxious to obtain new collections of the genus. Prof. M. E. Peck, of Oregon, has been the only energetic collector of this group in recent years. A botanist of similar energies and interest in California could add greatly to our knowledge of the rich and difficult *Allocarya* flora of that state.

KEY TO THE SPECIES

Plant perennial, coarse, covered with long soft spreading hairs.....1. *P. mollis*.

Plant annual, slender.

Plant floriferous to near base and with the lower pedicels stout and recurving; calyx strengthened by indurated ribs, the lobes eventually contorted and

irregularly spreading or recurving; stems prostrate.

Nutlets broadly ovate, glossy, very sparsely if at all tuberculate; scar $\frac{1}{3}$ - $\frac{1}{5}$ length of nutlet, surrounded by a high collar2. *P. scriptus*.

Nutlets lance-ovate, dull, granulate and tuberculate; scar $\frac{1}{5}$ length of nutlet, not surrounded by a high collar3. *P. humistratus*.

Plant not floriferous to base or if so the lower pedicels not stout and recurving.

Scar large, deeply excavated, lateral, $\frac{1}{4}$ - $\frac{1}{2}$ length of nutlet; nutlets frequently with prickles.

Spike in part distinctly geminate; plant erect, usually glabrous and somewhat succulent; nutlets ovate, 1.5 mm. long; scar elongate; corolla 4-6 mm. broad4. *P. strictus*.

Spikes not geminate.

Nutlets broad, about $\frac{2}{3}$ - $\frac{4}{5}$ as broad as long.

Nutlets 2.5-3 mm. long, not transversely rugose dorsally5. *P. Greenei*.

Nutlets 1.5-2 mm. long, transversely rugose dorsally.

Appendages on nutlets short and stout, covered with minute spreading conic-subulate trichomes6. *P. hystriculus*.

Appendages when present barbed or naked.

Nutlets with slender elongate apically glochidiate appendages.....7. *P. acanthocarpus*.

Nutlets with appendages absent or reduced to naked papillae.....7b. forma *papillatus*.

Nutlets elongate, about $\frac{1}{2}$ as broad as long.

Dorsal keel of nutlets knife-like, bearing coarse trichomes; back of nutlets glossy8. *P. Austinae*.

Dorsal keel not knife-like, the back of nutlets opaque and transversely rugose.

Calyx scarcely accrescent; nutlets ca. 1.5 mm. long.....9. *P. distantiflorus*.

Calyx evidently accrescent; nutlets ca. 2 mm. long.

Corolla 5-9 mm. broad.....10. *P. glyptocarpus*.

Corolla 2-3 mm. broad.....10b. var. *modestus*.

Scar smaller, not much if at all excavated but at times with margins somewhat upturned, hence flat to concave, $\frac{1}{5}$ length of nutlet or less.

Nutlet-attachment exactly basal or practically so, frequently substipitate; somewhat succulent light green plants with the calyx-lobes strongly costate.

- Plant prostrate; calyx-lobes connivent and together directed off towards one side of flower.....11. *P. leptocladus*.
- Plant erect or ascending; calyx-lobes centrifugally spreading.
- Plant stout, fistulous-enlarged; lateral keel on nutlets well developed; calyx with indurated ribs.....12. *P. glaber*.
- Plant more slender, not fistulous; lateral keels of nutlets less developed; calyx with weakly indurated ribs.
- Corolla 5-12 mm. broad.....13. *P. stipitatus*.
- Corolla 2-5 mm. broad.....13b. var. *micranthus*.
- Nutlet-attachment lateral to obliquely basal; calyx-ribs only exceptionally thickened.
- Scar linear or nearly so and usually borne on a narrow knife-like attachment (rarely cuneate and sessile in *P. undulatus*); coastal plants.
- Nutlets with attachment in an elongate depression and with only the basal portion of keel in any suggestion of a longitudinal groove.....14. *P. undulatus*.
- Nutlets with attachment and ventral keel lying in a pronounced strong longitudinal groove, this frequently even infolding and more or less hiding keel and attachment.
- Nutlets rough and dull, 1.3-1.9 mm. long; plant trailing or prostrate; corolla 5-10 mm. broad.
- Plant trailing, lower internodes elongate; corolla 6-10 mm. broad; pedicels mostly longer than calyx.....15. *P. Chorisianus*.
- Plant prostrate, lower internodes congested; corolla 5-6 mm. broad; pedicels usually shorter than calyx.
-15b. var. *Hickmanii*.
- Nutlets smooth and shiny, 2.5-3 mm. long; plant erect; corolla 2-4 mm. broad.
-16. *P. lithocaryus*.
- Scar broad, not linear, attachment not at all knife-like or if so the nutlets rather asymmetric.
- Racemes prevailingly geminate and bractless; erect dichotomous plants of the Northwest Coast; corolla 4-9 mm. broad.
- Pubescence appressed; mature calyx 2.5-4 mm. long; style not surpassing nutlets.
- Ridges and warts on nutlets low.....17. *P. Scouleri*.

- Ridges and warts on nutlets narrow and high.....17b. var. *corallicarpus*.
 Pubescence spreading; mature calyx ca. 5 mm. long; style surpassing nutlets17c. var. *hirtus*.
 Racemes solitary and bracted.
 Stems with distinctly spreading hairs.
 Nutlets 1.1-1.8 mm. long, with strong transverse ridges on back; scar lateral or oblique and suprabasal, seated in a groove formed by ridges in pericarp; racemes bracted sparingly at base; calyx tending to be deciduous.....18. *P. Parishii*.
 Nutlets 2-2.5 mm. long, with low transverse ridges above middle on back, scar on the oblique suprabasal lower portion of nutlet, not sunken in a groove formed by ridges in pericarp; racemes much bracted; calyx persistent.....19. *P. salsus*.
 Stems strigose or appressed hispidulous.
 Scar surrounded by ridges and wrinkles in the pericarp and in an areola broader than long, or the attendant ridges and wrinkles absent and areola not developed; nutlets tending to be asymmetric; ventral keel frequently folded over below the middle; plants mostly extra-Californian.
 Ventral keel of nutlet sunken in a broad strong groove formed by paralleling ridges in the pericarp; nutlets 1-2, plano-convex with the venter flat; pericarp thick and rather bony; corolla minute.20. *P. lamprocarpus*.
 Ventral keel prominent, not in a pronounced groove; nutlets all developing, not strikingly plano-convex; pericarp not bony.
 Corolla 2-5 mm. broad; plants mostly erect; tips of calyx-lobes usually distinctly ferruginous or fulvous; west of Cascades.
 Racemes rather dense, bracted only at base, some tending to be geminate.....21. *P. granulatus*.

- Racemes loose, bracted at least to middle, simple.....22. *P. medius*.
 Corolla 1-2 mm. broad; plants mostly spreading; tips of calyx-lobes not conspicuously if at all colored; east of Cascades and Sierras.
 Scar ovate to triangular, the thickish margins usually divergent or spreading; nutlets mostly dull.....23. *P. cognatus*.
 Scar (at least in homomorphous nutlets) elongate, with knife-like erect strongly ascending or even inflexed edges; nutlets glossy.
 Nutlets rugose and tuberculate.
24. *P. Cusickii*.
 Nutlets smooth.....25. *P. nitens*.
 Scar surrounded by strong ridges in the pericarp, the ridges enclosing an areola as long or longer than broad; nutlets symmetric or only slightly asymmetric; ventral keel erect; plants mostly Californian.
 Ventral keel not in a distinct trough, the attendant ridges appressed to base of keel or even joined to it and usually irregular or broken.
 Corolla 3-7 mm. broad; racemes bractless or practically so; plant erect, slender, inconspicuously pubescent; Northern California.
 Scar of nutlet lateral, lying in plane of ventral keel.
 Plant very slender, not at all succulent; calyx not strict, the lobes usually ascending; corolla 3-7 mm. broad.....26. *P. tener*.
 Plants slightly succulent; calyx strict, its lobes connivent and erect; corolla 3 mm. broad.....26b. var. *subglaber*.
 Scar on oblique base of nutlet.
26c. var. *fallax*.
 Corolla smaller, 1-3.5 mm. broad; racemes more or less abundantly bracted.
 Scar and ridge surrounding it

more or less distinctly oblique
to the plane of the ventral keel,
suprabasal to nearly basal.

Nutlets lacking trichomes...27. *P. bracteatus*.

Nutlets bearing minute apically
barbed trichomes....27b. var *aculeolatus*.

Scar distinctly lateral, the ridges
surrounding it in the plane of
the ventral keel or practically
so.

Nutlets narrowly ovoid, with
obliquely narrow ridges,
usually muriculate or mi-
nutely bristly; calyx 1-2
times length of fruit; scar
narrow, at most obovate or
elliptic; pine-belt of Sierras
and northeastward....28. *P. hispidulus*.

Nutlets angulately ovate, usually
with strong well-spaced
transverse ridges, not muri-
culate or bristly; calyx com-
monly 2-3 times length of
fruit; scar expanded, ovate
to deltoid; Coast Ranges
and mesas of western Cali-
fornia.....29. *P. trachycarpus*.

Ventral keel (below the middle at
least) in a conspicuous trough
formed by attendant forward pro-
longations of the ridge surround-
ing the scar, distinct from the
attendant ridges and not joined nor
closely appressed to them.

Nutlets densely tuberculate between
the ridges, densely granu-
late, the pericarp thick and
rather bony.....30. *P. diffusus*.

Nutlets sparsely if at all tuberculate,
usually sparsely granulate,
the pericarp rather thin.

Nutlet ovate, rather plump, loosely
reticulate-rugose; ventral keel
in a broad open groove...31. *P. reticulatus*.

Nutlets oblong-ovate, less plump
and more granulate, trans-
versely rugose; ventral keel in
a narrower, less perfect
groove.....31b. var. *rossianorum*.

SYSTEMATIC ACCOUNT

1. **Plagiobothrys mollis** (Gray) Johnston, Contr. Gray Herb. 68:74 (1923). *Eritrichium molle* Gray, Proc. Amer. Acad. 19:89 (1883). *Krynitzkia mollis* Gray, Proc. Amer. Acad. 20:267 (1885). *Allocarya mollis* Greene, Pittonia 1:20 (1887).

Coarse perennial from a fleshy taproot, covered throughout with long soft mostly spreading hairs, 5-15 cm. tall; stems numerous, spreading, branched, 1-3 dm. long and laxly ascending, or trailing with rooting nodes and 5-10 dm. long; leaves numerous, all opposite, 4-8 cm. long, 4-8 mm. broad, obtuse or rounded, linear to linear-spathulate or narrowly oblong; racemes becoming 3-10 cm. long, borne singly and almost always terminating a leafy branch, frequently bracted at base, dense to loose, just projecting above the leafy mass of the plant; bracts alternate; pedicels 1-2(-3) mm. long, slender; mature calyx 4-5 mm. long; lobes lance-cuneate, ascending or nearly erect; corolla conspicuous, tube slightly shorter than calyx, limb 5-10 mm. broad; style surpassing nutlets, frequently much so; nutlets ovate, ca. 1.5 mm. long; dorsum marked by irregular transverse ridges that may become indistinct and more or less replaced by tuberculations towards the base, transverse ridges merging somewhat towards the sides to form indefinite lateral keels, medial keel distinct chiefly towards apex but frequently extending down to the middle; venter with a conspicuous ovate or triangular submedial scar.

Moist alkaline soils from Sierra to Modoc counties, California, and adjacent Nevada, north into eastern (Klamath to Harney counties) Oregon.

CALIFORNIA: Sierra Valley, Sierra Co., 1879, *Lemmon* 53 (G); Sierra Valley, 1874, *Lemmon* 498 and 1267 (G); Sierra Valley, 1883, *Lemmon* (TYPE, G.); Loyalton, Sierra Co., *Eastwood* 7847 (CAc); Portola, Plumas Co., July 30, 1911, *K. Brandegee* (UC); Prattville, Plumas Co., 4500 ft., *Howell* 2156 (UC); banks of Pitt River below Alturas, Modoc Co., July 1887, *Austin* (UC); shore of Egg Lake, Modoc Co., *Baker* (ND).

NEVADA: in wet places near Washoe Lake, July 1919, *Tidestrom* 10459 (NY); northwestern Nevada, 1875, *Lemmon* (G).

OREGON: moist borders of Klamath Lake, *Henderson* 12858 (Eug.); Sprague River Valley near Yainax Bridge, Klamath Co., *Coville & Leiberg* 320 (US); edge of swamp, Swan Lake Valley, Klamath Co., *Applegate* 371 (G); Klamath River near Keno, *Cusick* 2843 (G);

moist ground, Keno, Klamath Co., *Peck* 9404 (G); moist to wet places in fields near Burns, Harney Co., *Henderson* 8288 and 8289 (Eug.); Malheur Lake bottoms, Harney Co., *Griffiths & Morris* 733 (US); along Silvies River near mouth of Emmigrant Creek, Harney Co., *Peck* 2544 (G); alkaline soil of Harney Valley, Harney Co., *Cusick* 2045 (G); swamp near P-Ranch, *Cusick* 2599 (G).

Var. *vestitus* (Greene) Johnston, Contr. Gray Herb. 68:75 (1923). *Allocarya vestita* Greene, Erythea 3:125 (1895). *Allocarya mollis* var. *vestita* Jepson, Fl. West. Mid. Calif. 442 (1901).

A more rank, decumbent rather than creeping plant, with some of the upper leaves on the main axis alternate; branches usually bearing two or more quite bractless racemes; nutlets more or less reticulate with the large interspaces somewhat granulate, lateral keels undeveloped.

Known definitely only from near Petaluma, Santa Clara Valley, California. There is also, however, a questionable record from Visalia in the San Joaquin Valley, California.

CALIFORNIA: Petaluma, Sonoma Co., July 1880, *Congdon* (TYPE, ND; ISOTYPES G, UC). Visalia, Sept. 1882, *Congdon* (G).

Plagiobothrys mollis is an outstanding species in the genus and one of the most distinct members of the section *Allocarya*. Its relationships are obscure but probably lie with the perennial species of the Andes. A letter sent Gray by Lemmon in 1883 gives interesting field observations on the plant at Sierra Valley. Lemmon writes, "Around the borders of certain alkali flats and creeping into the adjacent meadows where the water has evaporated, this plant is found growing in large round patches, highest in the center and finally touching each other and covering the whole ground. Evidently the original plants are few, the branches rooting at the joints, branching again, and creeping several feet." The flowers are given as large, white and very fragrant, the odor suggesting that of sweetpeas.

The plant I have accepted as var. *vestitus* may merit specific rank but until more is known of it I believe it had best be treated conservatively. There are two localities reported for it, Petaluma, Sonoma Co., and Visalia, Tulare Co., California. The range thus determined is a most unusual and peculiar one in California botany. This fact has aroused my suspicion and the basis of the two records has been carefully scrutinized I am now of the opinion that only the Petaluma record is trust-

worthy. The only specimen attributed to *Visalia* is preserved in the Gray Herbarium. It bears the collector's number 166 and is accompanied by a label in Gray's hand giving the following data, "Visalia, Congdon 166, Sept. 1882." The *Petaluma* record is represented in several herbaria by generous material accompanied by Congdon's personal label bearing data written in by himself and giving the collection date as July 1880. A close comparison of the *Petaluma* and the so-called *Visalia* collection shows that they agree in all minute details of discoloration, maturity, nature of pressing, etc., which give every reason for believing they are merely parts of a single collection. According to Jepson, Madroño, 1:175-177 (1928), Congdon was living in *Petaluma* in 1880, and in *Visalia* the following year. I believe that the so-called *Visalia* collection was one collected at *Petaluma* and sent to Gray a year later from the *Visalia* post office. In other words the *Visalia* record is in all probability another case of that old source of error, the mistaking of the point of dispatch of specimens for their place of collection. Consequently I am of the opinion that Congdon's collections represent a local plant of the Santa Clara Valley and one now perhaps exterminated by the extensive cultivation of land throughout that region, particularly about *Petaluma*.

2. ***Plagiobothrys scriptus*** (Greene), comb. nov. *Allocarya scripta* Greene, *Pittonia* 1:142 (1887).

Annual, apparently slightly succulent, strigose, spreading with elongate divergent basal branches, lower internodes short and congested; branches wiry, 5-20 cm. long, floriferous to near base; leaves glabrous above or nearly so, loosely strigose beneath, lower ones linear, the upper oblanceolate; racemes loosely flowered, leafy bracted; pedicels stout, recurving, lower ones 2-2.5 mm. long; mature calyx accrescent, loosely hispidulous; lobes linear, 7-8 mm. long, ca. 0.7 mm. broad, loosely erect or ascending and apparently at last becoming contorted and recurving, base of calyx and lower part of lobes strengthened by prominent indurated ribs; corolla only slightly surpassing calyx, ca. 2 mm. broad; nutlets ovate, 2 mm. long, 1.6 mm. broad, glossy and dark with pale ridges and keels which bear scattered slender branched hairs; dorsum medially keeled

to base, lateral keels present, marked between the keels with loosely reticular transverse ridges; venter loosely rugose and with a very prominent keel to below the middle; scar large, suprabasal, somewhat oblique, deltoid, excavated, surrounded by a high collar formed of the upturned pericarpial margin (this encircled by a distinct ridge in the pericarp just outside), $1/3-1/5$ the length of the nutlet.

Central California (lower Sacramento Valley); rare.

CALIFORNIA: plains of the Sacramento River, *Parry* (TYPE, ND; *isotype*, NY); Ione, Amador Co., March 19, 1921, *Eastwood 1114* (G, CAc).

A very distinct species but one showing clear relationships with the habitally quite similar *P. humistratus*. The high-collared attachment-scar is most peculiar. The trichomes on the nutlets suggest those of *P. humistratus* though they might be simply flaccid derivatives of appendages such as those found in *P. Austinae*.

3. ***Plagiobothrys humistratus*** (Greene) Johnston, Contr. Gray Herb. 68:77 (1923). *Allocarya humistrata* Greene, Pittonia 1:16 (1887). *A. limicola* Piper, Contr. U. S. Nat. Herb. 22:97 (1920). *A. sigillata* Piper, l. c. 97 (1920). *A. humistrata* var. *similis* Jepson, Man. Fl. Pl. Calif. 853 (1925).

Annual, somewhat succulent, much branched at base with the lower internodes congested, prostrate or spreading; branches elongate, stiffish, divergent, 1-4 dm. long, usually floriferous to the base, bearing flowers between or opposite the leaves and hence chiefly inflorescence; leaves nearly glabrous above, sparsely strigose and usually somewhat pustulate beneath; basal leaves linear or oblance-linear, 3-8 cm. long, 2-3 mm. broad, their opposite arrangement almost completely obscured by the suppression of the lower internodes; upper leaves (or bracts) oblance-linear to narrowly oblanceolate; racemes somewhat one-sided, becoming loosely flowered below; pedicels stout, the upper ones suppressed, the lower ones 1-2 mm. long and more or less distinctly recurving; mature calyx much accrescent, sparsely strigose, the base and at least the lower part of lobes strengthened by prominent indurated ribs; lobes subulate to narrowly spathulate, 6-10 mm. long, 0.5-1.2 mm. broad, at first connivent and together directed off to one side but later becoming contorted and spreading or even deflexed; corolla incon-

spicuous, scarcely surpassing the calyx, 1-2 mm. broad; style short, not reaching middle of nutlet; nutlets lance-ovate, 2-2.5 mm. long, 1-1.3 mm. broad; dorsum keeled medially to base or nearly so, irregularly transversely ridged with broad tuberculate interspaces, keeled laterally, surface smooth or granulate or more or less bristly; venter angulate, keeled nearly to base; scar suprabasal somewhat oblique, deltoid to ovate, usually concave, surrounded by a distinct ridge in the pericarp, expanded and usually flanged basally, ca. $1/5$ length of nutlet.

Central California (Sacramento and lower San Joaquin valleys); rare.

CALIFORNIA: Willows, Glenn Co., April 10, 1921, *Eastwood* 10209 (CAc, G); Colusa County, 1884, *Curran* (G); near Antioch, Contra Costa Co., 1884, *Curran* (CAc, UC); Antioch, April 7, 1885, *Greene* (ND, TYPE of *A. sigillata*); San Joaquin Valley, May 1884, *Greene* (G, TYPE of *A. limicola*).

A well marked species closely related to *P. scriptus* and possibly also with some relations in *P. trachycarpus*. Though it has a habit very much suggesting *P. leptocladus*, I do not believe it is very closely related to that species.

Greene's original description of *A. humistrata* is based upon a suite of specimens representing *P. leptocladus* as well as the present species. No specimens were cited nor was any type indicated. His references to Gray's writings and his mention of San Diego in his general statement of range would incline one to treat *P. humistratus* as synonymous with *P. leptocladus*. This has been recently done by Jepson, *Man. Fl. Pl. Calif.* 853 (1925). Greene's original description, however, more aptly describes the present plant, particularly as to the pedicels and as to the shape and the keels of the nutlets. The mixed character of Greene's species was first recognized by Piper, l. c. 92 and 98. As he first designated the elements involved in Greene's aggregate, and in the absence of a designated type, arbitrarily selected the present element as typical, I believe his decision should be accepted and treated as final. Accordingly I am designating as type of *A. humistrata* the collection made near Antioch by Mrs. Curran in 1884, since annotations seem to indicate that Piper had so accepted it. This is in accord also with the opinions of Mrs. Brandege, for she has marked this same collection in the California Academy as "type" and the part of it at Berkeley as "part of type." It is to be noted

that this collection from Antioch is probably also the type of *A. humistrata* var. *similis* Jepson. Piper's *A. sigillata* is a form of the species with the nutlets not very prominently rugose. The fruit bears only a few tufts of hairs. The type of *A. limicola* has the hairs on the nutlets reduced to coarse granulations.

4. **Plagiobothrys strictus** (Greene) Johnston, Contr. Gray Herb. 68:78 (1923). *Allocarya stricta* Greene, Pittonia 2:231 (1892). *A. californica* var. *stricta* Jepson, Fl. West. Mid. Calif. 443 (1901).

Annual, slender, erect, somewhat succulent, 1-4 dm. tall, nearly glabrous; stems simple or branched more or less throughout; branches elongate, strict, mostly dichotomous; leaves glabrous or with a few short hairs from pustulate bases, only the few reduced upper ones below the racemes alternate; lower leaves linear 4-9 cm. long, 1.5-2.5 mm. broad, obtuse; racemes slender, solitary or commonly several and distinctly geminate, naked or bracted only at base, elongating; pedicels 1 mm. long, strict; mature calyx weakly accrescent, ca. 3 mm. long, strigose and usually tawny; lobes obtuse, narrowly lance-oblong, about half again as long as the nutlets, erect or ascending; corolla conspicuous, 4-6 mm. broad; style $\frac{1}{2}$ - $\frac{3}{4}$ length of nutlets; nutlets ovate to narrowly ovate, rounded, depressed, 1.3-1.7 mm. long, 0.6-0.9 mm. broad; dorsum distinctly keeled to about middle, weakly keeled on edges, granulate, tuberculate and more or less abundantly transverse-rugose with the ridges usually papillate-dentate and prominent; venter with abundant obliquely transverse rugosities; scar lateral, supra-basal, $\frac{1}{3}$ - $\frac{2}{5}$ length of nutlet, excavated, narrow, its apical half frequently closed by the infolding of its margins.

Upper Napa Valley, California, about the hot springs near Calistoga.

CALIFORNIA: Calistoga, Napa Co., April 20, 1892, *Greene* (ND, TYPE; G, *isotype*); Calistoga, 1915, *Eastwood* 4627 (G); Calistoga, May 7, 1900, *Eastwood* (G); Calistoga Hot Springs, *Tracy* 1857 (G); alkaline field, geysers just NW of Calistoga, *Keck* 1095 (G); Myrtledale Hot Springs near Calistoga, *Howell* 1778 (CAc).

A well marked local species. Its salient characters are its frequently geminate spikes, rather glabrous somewhat succulent erect slender habit, conspicuous corollas, small strict calyces, and small usually grayish nutlets bearing a narrow

deeply excavated scar. Though evidently a member of the *Greenei* group its exact relations are uncertain.

5. **Plagiobothrys Greenei** (Gray) Johnston, Contr. Gray Herb. 68:76 (1923). *Echinospermum Greenei* Gray, Proc. Amer. Acad. 12:163 (1877). *Allocarya Greenei* Greene, Man. Bot. Reg. San Francisco Bay 259 (1894). *Echinoglochin Greenei* Brand in Fedde, Rep. Spec. Nov. 21:253 (1925). *Allocarya Echinoglochin* Greene, Pittonia 1:15 (1887).

Annual, erect to spreading, strigose; stems simple or branched from the base, 1-4 dm. long; branches simple or re-branched, springing from the axils of the upper opposite leaves; lower leaves linear or spathulate-linear, 1-6 cm. long, 1.5-2.5(-4) mm. broad, obtuse, crowded; upper leaves and bracts oblanceolate to narrowly oblong or linear; racemes becoming loose and elongate, single, bracted on lower part; pedicels slender, 1-2 mm. long, fulvous; mature calyx much accrescent, loose, broad; lobes lanceolate to ligulate, 4-7(-9) mm. long, 1-2 mm. broad, ascending or upcurved or almost stellately spreading, more or less tawny especially towards the acute apex; corolla surpassing the calyx 1.5 mm. or less, limb 2-5 mm. broad; style short, reaching scarcely above middle of nutlets; nutlets broadly ovate, dull, depressed, 2.5-3 mm. long, nearly 2 mm. broad, contracted towards apex; dorsum with a strong medial keel to the base or nearly so, usually also with weak lateral keels, finely and densely tuberculate and frequently muriculate, armed along the keels and in the area between them with numerous distinct well-spaced firm subulate apically glochidiate appendages 0.4-0.8 mm. long, transverse ridges completely absent; venter with a large deep ovate or deltoid broadly flanged lateral scar $1/3$ - $1/2$ length of nutlet.

Sonoma, Sacramento and San Joaquin counties, California, northward through the Sacramento Valley and into the Rogue River Valley of southwestern Oregon.

CALIFORNIA: vernal pool, Bennett Valley road near Summit, Sonoma Co., *Baker 2131a* (UC); open fields, Copperopolis road west of Peters, San Joaquin Co., *Stanford 1429* (G); Amador County, *Hansen* (ND); Ione, Amador Co., May 1890, *K. Brandegee* (UC); Folsom, Sacramento Co., June 1893, *K. Brandegee* (UC); grassy slope, north side of Maryville Buttes, Sutter Co., *Heller 11272* (G); open gravelly slopes between Shingle Springs and El Dorado, El Dorado Co., *Heller 12293* (G); adobe land east of Chico, Butte Co., April

1896, *Austin* (ND); grassy places in clay soil, low hills 8 mi. north of Oroville, Butte Co., *Heller* 11266 (G); banks of Pine Creek, 12 mi. north of Chico, Butte Co., *Heller* 12986 (G); Millville road near Redding, Shasta Co., 1896, *Baker* (ND); Yreka, Siskiyou Co., May 2, 1876, *Greene* 744 (G, TYPE).

OREGON: moist flats, Sam's Valley, Jackson Co., *Henderson* 12726 (Eug); moist gravelly meadows, Central Point, Jackson Co., May 6, 1887, *Henderson* (Eug); near Medford, Jackson Co., May 6, 1887, *Henderson* (Eug); moist flat near Merlin, Josephine Co., April 20, 1930, *Henderson* 12552 (Eug); Rogue River Valley, April 16, 1887, *Howell* (NY); southern Oregon, 1884, *Howell* 220 (G).

A distinctive plant very constant in its characters. Its large broad dull nutlets with well developed glochidiate appendages and lack of transverse ridging permit it to be quickly separated from such of its relatives as *P. Austinae* and *P. glyptocarpus* which appear to range with it in northern California and southwestern Oregon. Its closest relation appears to be *P. hystriculus* which replaces it in Solano County just to the east and north of San Francisco Bay. *Plagiobothrys hystriculus* has slightly smaller nutlets with shorter and much stouter abundantly muriculate appendages. The other close relative of *P. Greenei* is the more southern *P. acanthocarpus*.

6. ***Plagiobothrys hystriculus*** (Piper), comb. nov. *Allo-carya hystricula* Piper, Contr. U. S. Nat. Herb. 22:87 (1920). *A. Greenei* var. *hystricula* Jepson, Man. Fl. Pl. Calif. 853 (1925). *Echinoglochin hystricula* Brand in Fedde, Rep. Spec. Nov. 21:253 (1925).

Nutlets ca. 2 mm. long, armed with short stout appendages which tend to be joined by weak transverse ridges and are densely covered from base to apex with minute spreading conic-subulate trichomes; plant otherwise as in *P. acanthocarpus*.

Lower Sacramento Valley, California; rare.

CALIFORNIA: Montezuma Hills, Solano Co., May 14, 1892, *Jepson* (UC, TYPE; G, frag.) Elmira, Solano Co., May 3, 1886, *Greene* (G); Elmira, May 1883, *K. Brandegee* (UC); Sacramento Valley, May 2, 1886, *Greene* (NY, ND).

A local form more or less intermediate between *P. Greenei* and *P. acanthocarpus* though probably closest to the latter. The length of the stout appendages is only about 1/6 the width of the nutlet and is densely muriculate with minute conic divergent trichomes. In the related species the length of the

much more slender and more elongate appendages is $1/4$ to over $1/2$ the width of the nutlets and the appendages are barbed chiefly about the apex.

7. **Plagiobothrys acanthocarpus** (Piper), comb. nov. *Allo-carya acanthocarpa* Piper, Contr. U. S. Nat. Herb. 22:87 (1920). *Echinoglochin acanthocarpa* Brand in Fedde, Rep. Spec. Nov. 21:253 (1925). *A. oligochaeta* Piper, l. c. 88 (1920). *E. oligochaeta* Brand, l. c. 253 (1925). *A. acanthocarpa* var. *oligochaeta* Jepson, Man. Fl. Pl. Calif. 854 (1925). *A. echinacea* Piper, l. c. 88 (1920). *E. echinacea* Brand, l. c. 253 (1925). *A. acanthocarpa* var. *echinacea* Jepson, l. c. 853 (1925). *A. Eastwoodae* Piper, l. c. 89 (1920). *E. Eastwoodae* Brand, l. c. 253 (1925). *A. spiculifera* Piper, l. c. 90 (1920). *Glyptocaryopsis spiculifera* Brand, in Engler, Pflanzenr. IV-252² (Heft 97):104 (1931). *A. anaglyptica* Piper, l. c. 90 (1920). *G. anaglyptica* Brand, l. c. 104 (1931). *A. papillata* Piper, l. c. 91 (1920). *G. papillata* Brand, l. c. 104 (1931). *A. microcarpa* Piper, l. c. 91 (1920). *G. microcarpa* Brand, l. c. 105 (1931). *P. Piperi* Johnston, Contr. Gray Herb. 68:75 (1923).

Annual, slender, erect to spreading, strigose; stems usually branched below, 1-4 dm. long, branches simple or rebranched; lower leaves linear or spathulate-linear, 2-6 cm. long, 1.5-2.5 mm. broad, rather obtuse; upper leaves and bracts oblanceolate to narrowly oblong or linear; racemes becoming loose and elongate, bracted; pedicels slender, 1-2 mm. long; mature calyx broad and loose; lobes lanceolate (2-)3-5(-6) mm. long, 0.5-1 mm. broad, ascending or upcurved, becoming more or less stellately spreading, more or less tawny especially towards the acute apices; corolla scarcely if at all surpassing the calyx, limb 1-2.5 mm. broad; style short, reaching to about middle of nutlets; nutlets ovate, (1-)1.5-2(-2.5) mm. long, 0.8-1.5 but usually ca. 1.2 mm. broad, contracted towards apex; dorsum with a strong medial keel and more or less developed lateral ones, with transverse ridges and usually also with longitudinal ones somewhat paralleling the keels, consequently tending to be reticulate-rugose, tuberculate in the interspaces, armed sparsely to abundantly with stiff subulate apically glochidiate appendages, bases of appendages more or less completely inter-

joined by ridges and keels; venter with a large deeply excavated ovate or deltoid broadly flanged scar $1/4-1/3$ length of nutlet.

In and about the San Joaquin Valley of California and also in western San Diego county and adjacent Lower California.

LOWER CALIFORNIA: Tijuana Valley, March 31, 1886, *Orcutt 2261* (US).

CALIFORNIA: San Diego, May 1885, *Greene* (G); San Diego, March 13, 1882, *Jones 13* and *3072* (G); San Diego, March 1882, *Parry & Jones* (G); San Diego, March 1892, *Knight 10425* (G); sandy places near San Diego, *Spencer 4* (G); clay depressions, University Heights, San Diego, *Brandeggee* in Baker Dist., no. 825 (US, TYPE of *A. echinacea*; G, ISOTYPE); Point Loma, San Diego Co., 1885, *Greene* (ND); San Marcos, San Diego Co., April 21, 1882, *Cleveland* (US); Caliente, Kern Co., *Brandeggee* (UC, TYPE of *A. acanthocarpa*; G, frag.); Goshen, Tulare Co., May 1891, *Brandeggee* (UC); wet places, Lind Cove, Tulare Co., *Parks 439* (NY); dessicating mud-flat 4 mi. west of Springville, Tulare Co., *Munz 9120* (G); dried pool, 7 mi. east of Delano, Tulare Co., *Munz 9009* (G); Delano, Tulare Co., *Eastwood 3965* (CAc, TYPE of *A. papillata*; G, frag.); betw. Earlimart and Delano, Tulare Co., *Eastwood 3939* (CAc, TYPE of *A. anaglyptica*, G, frag.; US, TYPE of *A. spiculifera*, G, frag.); Guernsey, King Co., *Eastwood 3896* (US, TYPE of *A. Eastwoodae*; G, ISOTYPE); Alcalde, Fresno Co., March 29, 1893, *Brandeggee* (UC); vernal pools, 2 mi. south of Paicines, San Benito Co., *Howell 4580* (CAc); Merced, Merced Co., *Howell 4169* (CAc); Mariposa, Mariposa Co., May 10, 1897, *Congdon 48* (G, TYPE of *A. microcarpa*); Mariposa, April 15, 1895, *Congdon* (Stan); Lewis, Mariposa Co., April 17, 1892, *Congdon* (UC); Livermore Valley, Alameda Co., April 3, 1895, *Greene* (ND); Antioch, Contra Costa Co., *Eastwood 10253* (G); Antioch, *Davy 913* (UC); Byron Springs, Contra Costa Co., *Eastwood 3808* and *3832* (G); Byron, March 1889, *Greene* (ND); San Joaquin Valley, April 23, 1884, *Greene* (G, TYPE of *A. oligochaeta*).

A species evidently related to *P. Greenei* and *P. hystriculus*. It is most closely related to the latter and it is quite possible that eventually it will be shown to connect through that local species with *P. Greenei*. As now known, however, the three species are distinct and have ranges that meet but do not overlap. *Plagiobothrys acanthocarpus* and *P. Greenei* seem to differ somewhat in the selection of habitats, the former affecting depressions in low heavy soils whereas the latter tends to frequent moist grassy slopes and fields. In addition to having distinct transverse ridges on the nutlets, *P. acanthocarpus* differs from *P. Greenei* in being distinctly more slender in habit and in having perceptibly smaller nutlets.

In the arming of its nutlets *P. acanthocarpus* is conspicuously variable. The nutlets may be armed with slender elongate glochidiate appendages or these may be reduced to unarmed papillae or be entirely suppressed. These various forms are well connected by intermediates and frequently occur on plants within a single colony. Piper has proposed eight species to cover this variation. Brand has further dignified it by placing its extremes in different genera. *Allocarya acanthocarpa*, *A. oligochaeta*, *A. echinacea* and *A. Eastwoodae* are species based upon plants having the nutlets with slender glochidiate appendages. They differ somewhat in the abundance of appendages and in the amount of ridging on the nutlets. *Allocarya oligochaeta* is a transitional form bearing only a very few scattered glochidiate appendages. *Allocarya spiculifera*, *A. anaglyptica* and *A. papillata* are forms bearing nutlets having the appendages reduced to naked papillae. *Allocarya microcarpa* is a form devoid of appendages and even of papillae having the nutlets merely keeled and ridged. As it may be convenient to have a name for the forms with more or less suppressed appendages these may be called **P. acanthocarpus** forma **papillatus** (Piper), comb. nov. (*A. papillata* Piper).

Attention should be called to *P. gracilis* (R. & P.) Johnston, Contr. Gray Herb. 81:81 (1928), a species of central Chile which most obviously belongs with *P. acanthocarpus* in the specific group of *P. Greenei*. The only character that appears to set this austral plant off from its Californian relatives is its loosely rather than closely appressed pubescence. The nutlets are quite similar in size and shape to those found in *P. acanthocarpus*. The glochidiate appendages, however, seem to be scattered on the back of the nutlets less regularly and more numerous and furthermore are not connected by transverse ridges. As I have evaluated species in this group I believe that these differences are strong enough to set off the Chilean plant satisfactorily. I am inclined to believe, however, that if a broader species-concept becomes desirable, then the Chilean *P. gracilis* must become involved with our plants nomenclatorially. The name-bringing synonym of the latter is *Myosotis gracilis* Ruiz & Pavon, Fl. Peruv. 2:5 (1799), one of the oldest names in the genus.

8. **Plagiobothrys Austinae** (Greene), comb. nov. *Allocarya Austinae* Greene, Pittonia 1:18 (1887). *Echinoglochin Austinae* Brand in Fedde, Rep. Spec. Nov. 21:253 (1925). *A. cristata* Piper, Contr. U. S. Nat. Herb. 22:89 (1920). *E. cristata* Brand, l. c. 253 (1925). *A. Austinae* var. *cristata* Jepson, Man. Fl. Pl. Calif. 853 (1925).

Differing from *P. Greenei* only in its remarkable nutlets. Nutlets glossy, 2.5-3 mm. long, ca. 1.5 mm. broad, with an angular ovoid body that is abruptly contracted into an elongate laterally much compressed beak-like apex; dorsal keel complete, very well developed and knife-like; lateral keels obtuse, present on the body of the nutlet and frequently continuing forward on the lower edge of the nutlet along the beak; area between the keels irregularly tuberculate to obscurely tumulose or more or less smooth; dorsal keels (particularly the medial one towards the apex) armed with subulate-columnar (frequently antrorse) appendages, 0.4-0.8 mm. long bearing a plumose array of coarse spreading falcate hairs near their summit; attachment-scar triangular, excavated, $1/3$ to nearly $1/2$ length of nutlet.

Sacramento and lower San Joaquin valleys, California; rare.

CALIFORNIA: open range in wet places, northeastern San Joaquin County near the Calaveras line, April 14, 1930, *Stanford 1319* (G); Mokelumne Hill, Calaveras Co., *Blaisdell* (CAc, TYPE of *A. cristata*; G, frag.); Ione, Amador Co., March 19, 1921, *Eastwood 10100* (CAc); Butte County, May 1883, *Austin* (ND, TYPE of *A. Austinae*; G, ISOTYPE).

Quite like *P. Greenei* in habit but differing in its remarkable nutlets. These latter are peculiar not only for their strange shape but also for the coarseness of their appendages and for the coarse falcate recurving hairs borne upon them. The bizarre nutlets suggest abnormality. Had I only a single collection of the species available, I might have dismissed it as an abnormal form. The recurrence, however, of the plant in various localities with all its distinctive traits constant, not only throughout each plant but from plant to plant, leads me to believe it is as normal as *P. Greenei* and quite as worthy of specific recognition.

9. **Plagiobothrys distantiflorus** (Piper), comb. nov. *Allocarya distantiflora* Piper, Contr. U. S. Nat. Herb. 22:91

(1920). *Glyptocaryopsis distantiflora* Brand, in Engler, Pflanzenr. IV-252² (Heft 97):105 (1931).

Annual, apparently either laxly ascending or nearly prostrate; stems very slender and elongate, strigose, up to 3 dm. long, with long strict branches from the base; leaves with short loosely appressed hairs, somewhat ciliolate; lowermost leaves opposite and much congested, blade not seen; upper leaves oblanceolate to oblance-linear, 2-3 cm. long, 2-3 mm. broad, obtuse; racemes extremely elongate, becoming very distantly flowered in age, bracted throughout; pedicels ca. 1 mm. long; mature calyx weakly accrescent, 2.5-3 mm. long, loosely strigose, lobes linear to lance-linear; corolla minute, scarcely surpassing the calyx, limb 1-1.5 mm. broad; style reaching to about $\frac{3}{4}$ height of nutlets; nutlets elongate, angular, ca. 1.5 mm. long, ca. 0.7 mm. broad, somewhat incurved; dorsum with a dentate medial keel extending to below the middle of the fruit, the edges with dentate lateral keels, marked transversely by tuberculate and sparsely papillate wrinkles that are separated (especially towards apex) by lineate grooves, or with the wrinkles suppressed (particularly on axial nutlet) and with the tuberculations and papillae in more or less obscure transverse arrangement; venter with prominent crowded ridges; scar $\frac{1}{3}$ to $\frac{1}{2}$ length of nutlet, excavated, elongate and more or less constricted apically by the pinching in of the pericarpial wall, hence lance-ovate to cuneate or nearly linear.

Known only from the type-locality.

CALIFORNIA: Madera, Madera Co., April 1888, *Buckminster* (UC, TYPE; G, frag.).

Related to *P. glyptocarpus* and having fruit that is similar though much smaller than in that species. The habit of growth suggests that of slender forms of *P. hispidulus*.

10. **Plagiobothrys glyptocarpus** (Piper), comb. nov. *Allo-carya glyptocarpa* Piper, Contr. U. S. Nat. Herb. 22:90 (1920). *Glyptocaryopsis glyptocarpa* Brand, in Engler, Pflanzenr. IV-252² (Heft 97):104 (1931).

Annual, erect, 1-5 dm. tall, strigose, slender; stems with elongate ascending branches from the base; branches simple or ascendingly branched, springing from the axils of the alternate as well as opposite leaves; lower leaves linear or spathulate 4-8 cm. long, 2-4 mm. broad, obtuse, lower pairs either loose or

crowded; upper leaves oblanceolate to oblong-linear; racemes simple, slender, becoming loose and elongate, bracted towards the base; pedicels 1-2 mm. long, fulvous; mature calyx accrescent; lobes lanceolate or linear-lanceolate, 3-5 mm. long, 1 mm. broad, ascending, somewhat tawny towards the tips; corolla conspicuous, tube shorter than calyx; limb 5-9 mm. broad, surpassing the calyx 2-4 mm.; style reaching $\frac{2}{3}$ to $\frac{3}{4}$ height of nutlets; nutlets rather elongate, very angular, ovate to oblong-ovate, ca. 2 mm. long and ca. 1.2 mm. broad, incurved, one or more frequently aborted; dorsum with a strongly dentate medial keel particularly towards apex, keeled laterally, marked with more or less numerous strong dentate obliquely transverse ridges, tuberculate and granulate; venter with prominent crowded ridges; scar very deeply excavated, $\frac{1}{3}$ to $\frac{1}{2}$ length of nutlet, frequently somewhat covered by the ingrowth of the pericarp towards its summit.

Margins of Sacramento Valley, California, and in upper Rogue River Valley, Oregon.

CALIFORNIA: Hough's Springs, Lake Co., *Abrams 12532* in pt. (NY); near Clear Creek, Butte Co., *Brown 165* (NY); moist cultivated ground in low hills 8 mi. north of Oroville, Butte Co., *Heller 11202* (G, TYPE); Anderson, Shasta Co., *Jones 264a* (G).

OREGON: Ashland, Jackson Co., *Piper 5040* (G); 20 mi. east of Medford, Jackson Co., June 1927, *Heckner* (Stan).

Var. **modestus**, var. nov., a var. genuina differt corolla minori inconspicuaque 2-3 mm. diametro calycem minus quam 1 mm. superante.

Known only from type-locality.

CALIFORNIA: in the yellow pine and oak belt, Cedar Crest near Grass Valley, Nevada County, May 24, 1919, *Heller 13222* (G, TYPE).

Most closely related to *P. distantiflorus*, which is separated by its small weakly accrescent calyces, much smaller fruit and very slender habit. The nutlets are distinctly bent. The species is evidently a member of the *Greenei*-group.

11. **Plagiobothrys leptocladus** (Greene), comb. nov. *Allo-carya leptoclada* Greene, Pittonia 3:109 (1896). *Eritrichium californicum* var. *subglochidiatum* Gray in Brewer & Watson, Bot. Calif. 1:526 (1876). *Krynitzkia californica* var. *subglochidiata* Gray, Proc. Amer. Acad. 20:266 (1885). *A. californica* var. *subglochidiata* Jepson, Man. West. Mid. Calif.

443 (1901). *A. subglochidiata* Piper, Contr. U. S. Nat. Herb. 11:485 (1906). *A. orthocarpa* Greene, l. c. 4:235 (1901). *P. orthocarpus* Johnston, Contr. Gray Herb. 68:78 (1923). *A. oricola* Piper, l. c. 22:92 (1920). *A. divergens* Piper, l. c. 22:92 (1920). *P. divergens* Johnston, l. c. 77 (1923). *A. Wilcoxii* Piper, l. c. 22:93 (1920). *A. tuberculata* Piper, l. c. 22:95 (1920). *A. charaxata* Piper, l. c. 22:96 (1920). *A. versicolor* Brand in Fedde, Rep. Spec. Nov. 19:71 (1923).

Annual, somewhat succulent, strigose, prostrate, branched at the base with the lower internodes usually congested; stems straight, wiry, 1-3 dm. long, floriferous to base or nearly so and hence chiefly if not exclusively inflorescence; leaves nearly glabrous above, sparsely strigose and pustulate beneath; lower leaves linear to somewhat spathulate-linear, 3-10 cm. long, 2-4 mm. broad; upper leaves (bracts) oblance-linear to narrowly oblanceolate; racemes unilateral, simple, becoming rather loosely flowered; pedicels stout, usually 0-0.5 mm. long and strict, but the lowermost occasionally 1-15 mm. long and spreading; mature calyx usually accrescent, sparsely strigose, the base and at least the lower part of the lobes strengthened by prominent indurated ribs; lobes lanceolate to subulate or even somewhat linear-spathulate, 3-8 mm. long, 0.5-1 mm. broad, connivent or somewhat spreading but all more or less distinctly curved over towards one side of flower; corolla 1-2 mm. broad, scarcely if at all surpassing the calyx; style short, not reaching middle of nutlets; nutlets narrowly lanceolate to broadly lanceolate, acute, 1.5-2.5(-2.8) mm. long, 0.7-1 mm. broad; dorsum keeled only above middle, tuberculate, more or less abundantly (obliquely or transversely) rugose, smooth or granulate or penicillate-hairy; venter angulate, keeled whole length; scar exactly basal or practically so, not surrounded by a ridge in pericarp, horizontal or slightly oblique, sessile or subsessile, frequently with a downwardly directed dorsal flange.

Northernmost Lower California northward through California (in the coastal valleys in the south and in the great central valleys in the central and north parts of the state) into eastern Oregon, thence eastward in southern Idaho and northern Nevada to northern Utah.

LOWER CALIFORNIA: northern part, April 21, 1886, *Orcutt* 2260 (UC).

CALIFORNIA: San Diego, May 1885, *Greene* (G); drying vernal pools, March Field, Riverside Co., *Munz & Johnston* 5159 (G); mud flats near Moreno, Riverside Co., *Munz & Keck* 4988 and *Munz & Johnston* 5158 (G); drying mud flats, Menifee Valley, Riverside Co., *Munz & Johnston* 5369 (G); Perris, Riverside Co., *Parish* 9126 (Stan); clay mud flats south of Lake Elsinore, Riverside Co., *Munz* 5092 in pt. (G); low ground, Lake Elsinore, *Johnston* 1981 (G); mesas near Newport, Orange Co., 1882, *Nevin* (Stan, ISOTYPE of *A. versicolor*; G, frag.); Mohave, Kern Co., April 23, 1917, *Jones* (G); heavy adobe soil 7 mi. east of Delano, Kern Co., *Munz* 9006 (G); Corcoran, Kings Co., *Eastwood* 2874 (US, TYPE of *A. divergens*; G, ISOTYPE); Guernsey, Kings Co., *Eastwood* 3881 (US, TYPE of *A. charaxata*; G, ISOTYPE); dry mud flat, Ducor, Tulare Co., *Munz* 9037 (G); roadside ditch 4 mi. south of South Dos Palms, Fresno Co., *Ferris* 6949 (NY); 3 mi. east of Los Banos, Merced Co., 1925, *Abrams* 10758 (Stan); near Byron, Contra Costa Co., March 23, 1889, *Greene* (ND); Auburn, Placer Co., *Kellogg & Harford* (G); alkaline plain 4 mi. east of Williams, Colusa Co., *Ferris* 534 (NY); between Princeton and Norman, Glenn-Colusa Co., *Eastwood* 11197 (CAc).

OREGON: wet soil, Ontario, Malheur Co., *Leiberg* 2012 (G); camp on Pine Creek, Harney Co., *Leiberg* 166 (US, TYPE of *A. tuberculata*; G, ISOTYPE); dry stream bed 7 mi. west of Riley, Harney Co., *Peck* 13876 (G); moist ground, Kent, Sherman Co., *Peck* 9968 (G); dried bed of pool 10 mi. north of Shaniko, Sherman Co., *Peck* 13773 (G).

IDAHO: Boise, 1883, *Wilcox* (US, TYPE of *A. Wilcoxii*; G, frag.); drying lake bed, Shoshone, Lincoln Co., *Nelson & Macbride* 1170 (US, TYPE of *A. oricola*; G, ISOTYPE);

NEVADA: Clover Mts., Elko Co., Sept. 1868, *Watson* 851 (G, TYPE of *E. calif.* var. *subglochidiatum*); Pine Creek [south of Palisade], Eureka Co., July 20, 1896, *Greene* (ND, TYPE of *A. leptoclada*; G, frag.);

UTAH: edge of pond in alkaline soil, Flowing Well Lake, Salt Lake Co., *Garrett* 3100 (G); alkaline flat west of Salt Lake City, *Garrett* 3133 (G); salt flats 5 mi. west of Salt Lake City, *Garrett* 3279 (NY); near Salt Lake City, May 29, 1883, *Leonard* (NY); Hot Springs, Weber Co., *Jones* 468 (G); Cache Valley, Cache Co., June 17, 1898, *Mulford* 147 (ND, TYPE of *A. orthocarpa*; G, frag.).

This species was one of the two elements represented in the mixed suite of specimens upon which *Greene* based his *A. humistrata*. *Jepson* has recently applied that name to the present plant, but in accord with *Piper* and *Brand* I have felt that it had best be applied to the other element in *Greene's* complex, the rare strictly Californian plant which is a relative of *P. scriptus*. Though similar enough in gross habit to have been confused by *Greene* and to be thought worthy of only

varietal separation by Jepson, I believe the two plants to be distant relatives; *P. humistratus* (along with *P. scriptus*) being apparently derived from the species-group of *P. Greenei* whereas *P. leptocladus* apparently arose out of the species-group of *P. scopulorum*. Our plant, in fact, is very closely related to true *P. scopulorum* and seems to intergrade with it in the Rocky Mountain area. *Plagiobothrys scopulorum* tends to have the stiff stems, the slight succulence, the asymmetric calyces and elongate acute frequently hairy nutlets of *P. leptocladus* but differs in having a suprabasal rather than an exactly basal nutlet-attachment. Its range is in a contiguous area but at somewhat higher altitudes and off to the northeast of that occupied by *P. leptocladus*.

The nutlets of *P. leptocladus* may be trichome-bearing or glabrous. As in other species with this type of variation these extremes or their intermediates may be found in a single colony. Numerous segregate species, however, have been proposed to cover various aspects of this variation. The forms with glabrous nutlets are *A. orthocarpa*, *A. tuberculata* and *A. charaxata*. Among those with hairy nutlets Brand has proposed *A. versicolor*, making much of the nutlet-heteromorphy (one nutlet darker and more persistent than the other three) which he observed in the type-specimen. This phenomenon, however, is observable in more or less degree throughout *Allo-carya*. More to the point, however, is the fact that it is particularly well developed in species related to *P. scopulorum*. In this relationship the axial nutlet in each fruit may be more or less differentiated by a greater persistence, darker color, larger nutlet-attachment or by even size, shape and roughenings. Brand's *A. versicolor* certainly cannot be separated from the common Californian aspect of *P. leptocladus* which Piper has described as *A. divergens*.

Gray's var. *subglochidiatum* was left among the unplaced names by Piper, l. c. 22:113 (1920). From my studies I am inclined to believe it belongs here. The variety was described as follows,—“Somewhat succulent: nutlets when young more or less hirsute or hispid (especially on the crests of the rugosities), some of the bristles at length stouter and glochidiate under a lense; the roundish carunculate scar almost strictly basal . . . The remarkable variety (which passes into the

accompanying ordinary form), Placer to Sierra Co. (*Kellogg, Lemmon*), Nevada (*Watson*), etc." The description consequently fits our plant. There is no collection in the Gray Herbarium labeled as collected by Kellogg in Placer County, California, but there is a pocket, mounted on a sheet bearing four Nevadan collections by Watson (all numbered 851, but all from different localities), which bears in Gray's script the following data,—“Nutlets from 772. v. Kellogg & Harford (Auburn).” Auburn is the county seat of Placer County. The few nutlets in this pocket are evidently those of this species and probably represent fragments retained by Gray when this collection by Kellogg & Harford somehow passed through his hands. No other material that could possibly represent other parts of this Auburn collection was seen in any of the herbaria in which I studied. I suspect that the collection was from the California Academy herbarium and consequently destroyed in the San Francisco fire. A collection made by Lemmon (no. 492) in 1874 accounts for the mention of Sierra County. This specimen represents *P. hispidulus*. Of Watson's four collections from Nevada only one, from Clover Mt., Elko Co., has mature fruit. It clearly represents the present species. Hence in view of the fact that Lemmon's collection does not agree with the original description of Gray's variety, either in succulence or basal nutlet-attachment, the type of the variety must be either the Auburn or the Clover Mt. specimen. Since the former appears to be represented only by the few nutlets in the Gray Herbarium, I believe it quite sensible to accept Watson's fine collection from Clover Mt. as the type.

12. ***Plagiobothrys glaber*** (Gray) Johnston, Contr. Gray Herb. 68:77 (1923). *Lithospermum glabrum* Gray, Proc. Amer. Acad. 17:227 (1882). *Allocarya glabra* Macbride, Proc. Amer. Acad. 51:543 (1916). *A. salina* Jepson, Fl. West. Mid. Calif. 442 (1901).

Annual, yellowish green, coarse, stiff, erect, very sparsely and inconspicuously strigose, 1-1.5 dm. tall, strictly branched from the base, succulent; lower leaves linear, the upper ones somewhat oblanceolate, glabrous above, sparsely pustulate and strigose beneath; racemes somewhat fistulous; flowers rather crowded unilateral in two rather marked ranks, lower ones

leafy bracted; mature calyx broadly sessile, accrescent, 8-10 mm. long, united into a thick cylindrical strictly appressed base 2-3 mm. long, the lobes and particularly the base thickened and strengthened by indurated ribs, very sparsely strigose; lobes linear or spathulate-linear, rigidly ascending or spreading; corolla inconspicuous, scarcely surpassing the calyx, ca. 3 mm. broad; style reaching almost to middle of nutlets; nutlets lanceolate, 2 mm. long; dorsum with a medial keel above the middle, with rather definite lateral keels, tuberculate, with few weak transverse ridges chiefly above the middle, body usually flattened and the apex narrowed and beak-like; venter keeled its whole length, angulate, weakly tuberculate; scar basal, substipitate.

Southern shores of San Francisco Bay, California, and marshes of the adjacent Santa Clara Valley.

CALIFORNIA: Mt. Eden, Alameda Co., 1890 and 1893, *K. Brandegee* (UC); Alvarado, Alameda Co., *Jepson* (Herb. Jepson, TYPE of *A. salina*); Alviso, Santa Clara Co., 1893, *Bioletti* (ND); Los Gatos, Santa Clara Co., June 1894, *Cannon* (CAc).

ARIZONA?: "Apache Pass," 1881, *Lemmon* 485 (G, TYPE of *L. glabrum*; UC, ISOTYPE).

Although the type of *Lithospermum glabrum* is given as from Apache Pass, which lies north of the Chiricahua Mts. in eastern Cochise County, Arizona, no other collection of it is known from that state. The only material referable to the species comes from central California. Although Lemmon definitely listed the source of his no. 485 as from Apache Pass, Gray appears to have questioned it, for we find in a letter addressed to him by Lemmon under the date Jan. 1, 1882, the following,—“Yes, no. 485, *Lithospermum glabrum* seemed to be indigenous on the north slopes of Apache Pass.” Katherine Brandegee, *Zoe* 5:94 (1901), later questioned the record in print saying, “. . . inspection of a fragment, kindly furnished me by Mr. Lemmon, shows it to be a swollen form of the plant subsequently described as *Allocarya stipitata*. Some misplacement of labels is to be suspected, for the form is common in the Alameda marsh land, particularly about Mt. Eden, and is sometimes even stouter than the one in Mr. Lemmon’s herbarium.” Certainly a desert mountain slope is not a likely place for the present *Allocarya*, and I am fully content to accept the Arizona station as a mistake, since Lemmon could have more

believably collected it near Oakland, his home, or in the adjacent Alameda marshes mentioned by Mrs. Brandegee.

The species is a curious one obviously related to *P. stipitatus*. It seems to be a local derivative of that species distinguished chiefly by its very coarse fleshy fistulous habit. I shall not be surprised if future collecting and study give conclusive reasons for treating these plants as only varietally distinct at most. The differences are trivial ones and seem significant only so long as they are geographically correlated.

13. **Plagiobothrys stipitatus** (Greene) Johnston, Contr. Gray Herb. 68:77 (1923). *Allocarya stipitata* Greene, Pittonia 1:19 (1887). *Lappula stipitata* Druce, Rep. Bot. Exch. Cl. Brit. Isl. 5:38 (1918).

Annual, erect, 1-5 dm. tall, somewhat succulent, yellowish green, apparently glabrous but really sparsely and finely strigose, branching loose and ascending; leaves glabrous above, beneath strigose and usually somewhat pustulate; basal leaves linear, 2-11 cm. long, 1.5-4 mm. broad; upper leaves linear to oblanceolate; racemes stiffish, wiry, somewhat unilateral, rather loosely flowered, leafy bracted towards the base; pedicels stout, strict, 0-1 mm. long; mature calyx accrescent, more or less strigose, the base and the lower part of lobes more or less strengthened by prominent indurated ribs; lobes lanceolate to linear, ascending to spreading, 5-8 mm. long; corolla 5-12 mm. broad, evidently surpassing the calyx; style short, not reaching to middle of nutlets; nutlets lanceolate to lanceovate, 1.5-2.5 mm. long, 0.8-1.3 mm. broad, body usually distinctly compressed below the middle but thickened and constricted above into somewhat of a beak-like apex, straight or slightly out-curving; dorsum keeled only near apex and about margins, obliquely or transverse rugose especially above the middle, tuberculate especially below the middle; venter keeled to base, tuberculate or somewhat rugose; scar small, exactly basal, substipitate to quite sessile, dorsally with a downwardly directed flange.

Upper Rogue River Valley, Oregon, and Sacramento Valley, California. Having an outlying southern station in San Benito County.

CALIFORNIA: Hollister, San Benito Co., April 14, 1897, *Setchell* (UC); Elmira, Solano Co., 1886, *Greene* (G); Benicia, Solano Co.,

Jones 263a (G); near Suisun, Solano Co., 1886, *Greene* (G); near Fairfield, Solano Co., *Heller & Brown 5377* (G); moist meadow grounds at Vallejo, Solano Co., 1874, *Greene* (G); Napa, Napa Co., 1899, *Smythe* (G); Santa Rosa, Sonoma Co., *Eastwood 10318* (G); grassy field just above salt marsh north of Sears Point, Sonoma Co., *Keck 994* (G); wet soil, Mokelumne River bottom, Sacramento Co., *Stanford 1494* (G); Sacramento Valley, May, 1883, *Greene* (ND, ? TYPE of *A. stipitata*); Colusa County, 1884, *Curran* (G); low places along highway between El Dorado and Placerville, El Dorado Co., *Heller 12303* (G); Willows, Glenn Co., *Eastwood 10219a* (G); vernal pools on lava plains 9 mi. from Chico, Butte Co., *Heller 11317* (G); Anderson, Shasta Co., *Jones 265* (G).

OREGON: moist clay flats among oaks, Sams Valley, Jackson Co., May 4, 1930, *Henderson 12415* (Eug).

Var. *micranthus* (Piper), comb. nov. *Allocarya stipitata* subsp. *micrantha* Piper, Contr. U. S. Nat. Herb. 22:94 (1920). *A. stipitata* var. *micrantha* Macbride, Contr. Gray Herb. 65:43 (1922).

Differs only in its smaller corollas these being 2.5 mm. broad.

From the Mexican boundary northward through California and into southeastern Oregon; a common plant of the great central valleys of California.

CALIFORNIA: Campo, San Diego Co., May 9, 1916, *Parish 10814* (UC, Stan); Andrews Camp, Inyo Co., *K. Brandegee* (UC); Giant Forest, Tulare Co., *K. Brandegee* (UC); Hollister, San Benito Co., April 14, 1897, *Setchell* (UC); Merced, Merced Co., *Eastwood 4396* and *4425* (G); Chapman School House, Mariposa Co., April 27, 1897, *Congdon 53* (G); Bridal Veil Meadows, Yosemite, Mariposa Co., 4000 ft., *Hall 8875* (UC); sites of vernal pools, Bethany, San Joaquin Co., *Baker 2788* (G); wet soil, Collegeville, San Joaquin Co., *Stanford 852* (G); open field near Stockton, San Joaquin Co., *Stanford 112* (G); Stockton, April 28, 1889, *Greene* (US, TYPE); Livermore Pass, Alameda Co., *Brewer 1188* (G); dried roadside hollow 1 mi. east of Livermore Pass on road to Altamont Pass, *Howell 5331* (G); Antioch, Contra Costa Co., *Heller 8885* (G); Antioch, *Eastwood 10246* (G); Antioch, 1886, *Curran* (G); site of vernal pools on alkaline plains, Byron, Contra Costa Co., *Baker 2799* (G); Byron Springs, *Eastwood 3777* and *3822* (G); Madrono, Santa Clara Co., 1896, *Jepson* (G); Elmira, Solano Co., 1885, *Greene* (G); near Fairfield, Solano Co., *Heller & Brown 5375* (G); wet soil, Mokelumne River bottom, Sacramento Co., *Stanford 1495* (G); Willows, Glenn Co., *Eastwood 10226* (G); low places in moist adobe 6 mi. northwest of Chico, Butte Co., *Heller 11470* (G); vernal pool in adobe 8 mi. north of Oroville, Butte Co., *Heller 11308* (G); Blavo, Butte Co., *Piper 5008* and *5009* (G); Anderson, Shasta Co., *Jones 264* (G).

OREGON: about pool 7 mi. west of Riley, Harney Co., June 22, 1925,

Peck 13889 (G); at pond 4 km. north of B. Spr., 1470 m. alt., June 30, 1894, Leiberg 362 (G).

The variation in corolla-size in this species is conspicuous. The very large-flowered forms seem to be almost restricted to the area north of San Francisco Bay and while occurring with the small-flowered variety seem, in the main, readily separable from it. In the San Joaquin Valley south of San Francisco Bay, however, the plants have usually only medium-sized or small corollas. The transition between the flower-sizes is here very complete. In the Sacramento Valley there is much evidence to indicate that the large-flowered and small-flowered plants grow together with few, if any, transitional forms. These facts have led me to believe that flower-size is worthy of some nomenclatorial recognition.

The species through its var. *micranthus* is probably a derivative of *P. bracteatus*. Though connected by some transitional forms I feel that the two species are worthy of recognition, being in the main separable by differences in habit of growth, nutlet-attachment and nutlet-shape. The var. *micranthus*, however, connects *P. stipitatus* very much more closely with *P. glaber*. The characters setting it off from that species are suspicious ones of nutlet-ridging and habit. Further studies may show them to be scarcely more than varietal.

The nutlet of *P. stipitatus* is rather characteristic. The body is flattened on the back and is abruptly contracted into a laterally compressed beak-like apex. The whole nutlet appears to be slightly bowed-in dorsally and hence somewhat outcurving rather than incurving as in most species of *Allocarya*.

14. **Plagiobothrys undulatus** (Piper), comb. nov. *Allocarya undulata* Piper, Contr. U. S. Nat. Herb. 22:104 (1920). *A. Chorisiana* var. *undulata* Jepson, Man. Fl. Pl. Calif. 852 (1925). *A. inornata* Piper, l. c. 106 (1920). (?) *A. corrugata* Piper, l. c. 110 (1920).

Annual, slender, sparsely strigulose or somewhat glabrescent, erect at first but becoming more or less sprawling in age, strictly to ascendingly branched, lower internodes rather well developed; branches not crowded, elongate, frequently re-branched, 1-3 dm. long; leaves usually sparsely strigose or appressed-hispidulous below and nearly glabrous above, not crowded; lower leaves 3-6 cm. long, 1-3 mm. broad, linear,

obtuse; upper leaves oblance-linear to oblanceolate; racemes loose, slender, some of the flowers below the middle bracted; mature calyx somewhat accrescent, appressed villous-hispidulous and usually tawny at the lobe-tips; lobes lanceolate, ca. 2 mm. long, acute, erect, $1\frac{1}{2}$ to nearly 2 times length of nutlets; pedicels 0.5-1 mm. long, ascending; corolla 1.5-2 mm. broad, surpassing calyx 0.5-1 mm.; style reaching to $\frac{3}{5}$ - $\frac{4}{5}$ height of nutlets; nutlets 1.1-1.7 mm. long, ovate to somewhat lance-ovate, depressed; dorsum medially keeled towards apex, transversely rugose with numerous crowded low rounded undulate more or less anastomosing ridges which tend to be replaced by low tuberculations towards the base, keeled laterally, very finely granulate; venter keeled for about $\frac{3}{5}$ length of nutlet when it is replaced by the distinctly linear or rarely cuneate-linear scar; scar slightly elevated, ca. $\frac{1}{5}$ length of nutlet, paralleled by weak ridges in the pericarp (which may continue along the lower end of the ventral keel) and so lying in an elongate depression, distinctly lateral and suprabasal.

San Diego to Marin Co., California, mostly within 25 miles of the coast.

CALIFORNIA: in clay depressions, Ramona, San Diego Co., *Brandegee* in Baker dist. no. 3380 (US, TYPE of *A. inornata*; G, ISOTYPE); damp places on mesa about 5 mi. north of San Diego, *Abrams* 3451 (NY); desiccated clay mud flat $\frac{1}{2}$ mi. south of Lake Elsinore, Riverside Co., *Munz* 5092 (G); Ojai, Ventura Co., *Hubby* 104 (Stan); near Santa Barbara, Santa Barbara Co., 1888, *Brandegee* (UC); grainfield near ocean, Santa Barbara, May 15, 1907, *Eastwood* (CAc, TYPE of *A. undulata*; G, frag.); dried mud flat 5 mi. from Buellton on Lompoc road, Santa Barbara Co., *Munz* 9264 (G); Guernsey, Kings Co., *Eastwood* (US, TYPE of *A. corrugata*; G, ISOTYPE); Pilarcitos Lake and Canyon, San Mateo Co., *Davy* 1136 (UC); Lagunitas, Marin Co., April 1877, *Edwards* (NY); strand of Lake Lagunitas, Marin Co., Aug. 15, 1926, *Howell* 2186 (CAc).

This plant has the gross habit of slender forms of *P. hispidulus* but grows at low altitudes west of the mountains and has a very narrow more or less linear nutlet-attachment which is placed in an elongate depression. Its relations are not evident. Perhaps it belongs with the other coastal species such as *P. reticulatus* and *P. Chorisianus*. Piper's *Allocarya inornata* and *A. undulata* seem to be clearly conspecific. It is only with doubt, however, that I refer here the type of *A. corrugata*.

That plant comes from well up the San Joaquin Valley and seems to be less hairy and more erect. The nutlet-attachment seems to be in a depression less well marked than in *A. undulata* and the scar itself tends to be not so clearly linear. More collections of this form are needed before its status can be satisfactorily determined.

15. **Plagiobothrys Chorisianus** (Cham.) Johnston, Contr. Gray Herb. 68:77 (1923). *Myosotis Chorisiana* Chamisso, Linnaea 4:444 (1829). *Eritrichium Chorisianum* De Candolle, Prodr. 10:130 (1846). *Krynitzkia Chorisiana* Gray, Proc. Amer. Acad. 20:267 (1885). *Allocarya Chorisiana* Greene, Pittonia 1:13 (1887). *Eritrichium connatifolium* Kellogg, Proc. Calif. Acad. 2:163, fig. 51 (1862).

Annual, sparingly strigose; stems 1-4 dm. long, trailing, usually simple below with rather elongate internodes, bearing branches from the axils of the two uppermost of the 5-8 pairs of opposite leaves, dichotomous above, loosely branched; lower leaves all opposite, 3-7 cm. long, 2-8 mm. broad, firm, sparsely ciliate, rather obtuse, bases of the several lowermost conspicuously connate (for 3-4 mm.) and forming loose evident sheathes; upper leaves lance-oblong or oblong-spathulate, 1-3 cm. long, 2.5-5 mm. broad; racemes simple, elongate, becoming loose, bracted; pedicels 1.5-30 mm. long, conspicuously changing in texture, indument and direction 1.5-2 mm. below the calyx, all much elongate or only the lowermost conspicuously so, mostly longer than the calyx; mature calyx ca. 4 mm. long, usually tawny; lobes lanceolate, ascending to strictly ascending, indument appressed with a few short ascending bristles; corolla conspicuous, 6-10 mm. broad; style reaching up to $\frac{3}{4}$ to $\frac{7}{8}$ height of nutlets; nutlets ovate, 1.3-1.9 mm. long; dorsum keeled only near apex, loosely tuberculate, with scattered irregular (frequently somewhat reticulate) transverse ridges, surface granulate; venter with a distinctly lateral suprabasal knife-like attachment bearing the linear scar; attachment and the well developed ventral keel seated in a pronounced longitudinal groove that may be evidently open or may infold and almost hide the keel and attachment.

San Francisco to Santa Cruz Co., California.

CALIFORNIA: San Francisco, *Vasey* (G); wet places, San Francisco, *Bolander* 149 (G); San Francisco, *Mann* (G); San Francisco, *Bloom-*

er (CAc, TYPE of *E. connatifolium*); wet sandy ground near Lake Merced, San Mateo Co., *Heller* 8439 (G); Belmont, San Mateo Co., June 1886, *Greene* (G); common about hillsides, Crystal Springs Lake, San Mateo Co., *Baker* 429 (G); Crystal Springs, April 1896, *Eastwood* (UC); Searsville, San Mateo Co., May 20, 1890, *Brandegee* (UC); cliffs west of Colma, San Mateo Co., *Chandler* 806 (UC); Santa Cruz, April 15, 1897, *Setchell* (UC).

Var. **Hickmanii** (Greene), comb. nov. *Allocarya Hickmanii* Greene, *Pittonia* 1:13 (1887). *A. Chorisiana* var. *Hickmannii* Jepson, *Man. Fl. Pl. Calif.* 852 (1925). *A. myriantha* Greene, *Erythea* 3:125 (1895). *A. Chorisiana* var. *myriantha* Jepson, l. c. 852 (1925). *A. Jonesii* Brand in Fedde, *Rep. Spec. Nov.* 18:313 (1922).

Plant prostrate, branched from the base, with much reduced lower internodes; sheathing leaf-bases not noticeably if at all developed; corolla 5-6 mm. broad; pedicels prevailingly shorter than calyx.

Monterey Region, southward along the Californian coast to northern San Luis Obispo County; with an outlying station in "Los Angeles County."

CALIFORNIA: Ben Lomond, Santa Cruz Co., April 25, 1890, *K. Brandegee* (UC); Santa Cruz, 1889, *Cone* (G); Santa Cruz, April 16, 1899, *Davy* (G); summit road near Wright's, Santa Clara Co., *Dod* 1146 (CAc); Monterey, *Gambel* (G); dry woods, Monterey, *Guirado* 664 (G); Monterey, May 27, 1895, *Greene* (ND, TYPE of *A. myriantha*; G, frag.); beach near Pacific Grove, Monterey Co., *Heller* 6748 (G); pine woods, Pacific Grove, May 10, 1903, *Heller* (G); near Monterey on Carmel road, *Heller* 6825 (G); on the Salinas road near Del Monte, Monterey Co., *Heller* 6696 (G); weather beaten shore-rocks, Cypress Point, Monterey, 1885, *Gray* (G); Point Sur, Monterey Co., July 1888, *Brandegee* (UC); southern Monterey County, 1886, *Hickman* (ND, TYPE of *A. Hickmanii*; G, frag.); San Simeon, San Luis Obispo Co., June 9, 1889, *K. Brandegee* (UC); "Los Angeles County," *L. T. Chamberlain* (NY).

The type of *Myositis Chorisiana* was collected at San Francisco in 1816 during the visit of the Romanzoff expedition and was named in honor of L. J. Choris, who was artist and companion of Chamisso and Eschscholtz on that famous voyage. I have not seen any authentic material. The lengthy original description, however, applies clearly to this distinctive plant.

Material from the San Francisco peninsula is large-flowered, loose and trailing and usually branched only well above the base. The lower stem-internodes are very elongate and the

connate leaf-bases become conspicuously enlarged and quite loose and sheathing. Material from Monterey Bay and southward, however, tends to be much branched at the base and to have pedicels that average distinctly shorter and corollas that average distinctly smaller. The connate leaf-bases tend to be less developed and not so conspicuous. This southern plant I have called the var. *Hickmanii*. The extremes presented by the species and variety are very conspicuous. They are, however, well connected by transitional forms some of which are very difficult to place satisfactorily. It is even possible that we are dealing here with ecological forms reflecting the differences in climate between the northern and southern half of the range of the species as a whole. The type of *A. myriantha* is not an extreme of the var. *Hickmanii* as I have drawn that concept. It seems to be nearer the species in habit than most material I have seen from Monterey County. In nutlets it represents one of the common forms in which the ventral keel is in a deep open groove rather than a deep infolded one. The type of *A. Hickmanii* has the groove of the latter sort.

The species has, of course, an obvious relative in *P. lithocaryus* although certainly distinct from that remarkable species. The coastal distribution, the presence of the ventral keel in a distinct groove in the nutlets, and the frequent development of elongate lower pedicels seem to indicate that *P. reticulatus* also has affinities with *P. Chorisianus*. In fact I am inclined to believe that our plant may have been derived from that stock. The relations of *P. undulatus* are obscure but perhaps they also are to be found here. The depression below the middle of the nutlet and the knife-like more or less linear attachment borne in it would suggest such a relationship.

16. **Plagiobothrys lithocaryus** (Greene) Johnston, Contr. Gray Herb. 68:76 (1923). *Krynitzkia lithocarya* Greene ex Gray, Proc. Amer. Acad. 20:265 (1885). *Allocarya lithocarya* Greene, Pittonia 1:12 (1887).

Annual, erect, 1-3 dm. tall, pubescence fine and closely appressed; branches elongate, mostly simple springing chiefly from the upper pair of opposite leaves, lowermost internodes rather short, the other elongate; leaves rather obtuse, lowermost spathulate-linear, 3-6 cm. long, 2-4 mm. broad; uppermost oblanceo-

late or oblong-linear, 1-2.5 cm. long, 1.5-3 mm. broad; racemes simple, elongate, loose, bracted; pedicels slender, mostly 1-4 mm. long but the lowermost frequently becoming 10 mm. long; mature calyx ca. 4 mm. long; lobes subulate, ascending to erect, the tips usually somewhat tawny; corolla tube much shorter than calyx, limb ascending and 2-4 mm. broad; style short, reaching only to about middle of nutlets; nutlets 4 or by abortion usually fewer, ovoid, somewhat triquetrous particularly above the middle, 2.5-3 mm. long, ca. 1.5 mm. thick, shiny, apparently smooth but under high magnification minutely granular and abundantly and finely reticulate-rugulose; dorsum distinctly angled; venter flattened, marked its whole length by a deep narrow infolding groove in which are found more or less hidden the ventral keel and the knife-like attachment; attachment-scar linear, lateral and suprabasal.

North Coast Ranges of California; rare.

CALIFORNIA: Lakeport, Lake Co., May 1884, *Curran* (G, TYPE; UC, ISOTYPE); wet ground, Potter Valley, Mendocino Co., April 1899, *Purpus* (UC).

A very distinct species remarkable for its large shiny nearly smooth more or less triquetrous-ovoid nutlets. Though the habit is perhaps more suggestive of *P. Greenei* the sunken ventral keel and the elongate lower pedicels show a very much clearer relation with *P. Chorisianus*.

17. **Plagiobothrys Scouleri** (H. & A.) Johnston, Contr. Gray Herb. 68:75 (1923). *Myositis Scouleri* Hooker & Arnott, Bot. Beechey Voy. 370 (1840). *Eritrichium Scouleri* A. De Candolle, Prodr. 10:130 (1846). *Krynitzkia Scouleri* Gray, Proc. Amer. Acad. 20:267 (1885). *Allocarya Scouleri* Greene, Pittonia 1:18 (1887). *A. figurata* Piper, Contr. U. S. Nat. Herb. 22:101 (1920).

Annual, erect, 1-5 dm. tall, mostly dichotomous, sparsely and finely strigose; branches usually numerous, simple or once re-branched, usually ascending; leaves acute, lower ones subulate-linear, 4-12 cm. long, 2-4 mm. broad; upper leaves lance-linear to linear-lanceolate, 1-5 cm. long; racemes practically all geminate, slender, becoming 5-20 cm. long, bractless or bracted rarely at the very base; corolla conspicuous, 5-10 mm. broad, with exposed yellow intruded appendages; mature calyx loosely disposed, 2.5-4 mm. long; lobes lance-cuneate, erect,

usually somewhat tawny at apex; pedicels slender, mostly 1 mm. long but rarely even 2 mm. long; style reaching $3/4$ - $4/4$ length of nutlets; nutlets ovate, 1-1.5 mm. long, 0.7-1 mm. broad; dorsum convex, keeled at least down to middle, verrucose and frequently more or less obscurely and loosely transverse- or reticulate-rugose, the ridges usually tuberculate-dentate and best defined towards apex, surface usually granulate or muriculate or dull; venter bearing a distinctly lateral suprabasal well developed ovate scar.

Vancouver Island southward through western Washington and Oregon.

OREGON: in swale, Frye's Ranch, Illahe, Curry Co., *Nelson 1509* (G, TYPE of *A. figurata*); margins of ponds 1 mi. east of Waldo, Josephine Co., *Peck 8420* (G); wet place along road 1 mi. from Takilma, Josephine Co., *Henderson 5882* (G); drying black adobe, Sam's Valley, Jackson Co., *Henderson 12727* (Eug); dried pond, Wolf Creek, west of Crow, Lane Co., June 20, 1928, *Patterson* (UC); Corvallis, Benton Co., May 6, 1915, *Owens* (Corv); wet meadow, Chemawa, Marion Co., *Nelson 1207* (G); Gladstone, Clackamas Co., *Piper 6190* (G); Gladstone, *Howell 427* (UC); Oregon City, Clackamas Co., *Kellogg & Harford 767* (G).

WASHINGTON: near Union City, Mason Co., *Piper 1053* (G); in water, Klickitat Co., *Suksdorf 45* (G).

BRITISH COLUMBIA, Vancouver Isl.: Wellington, June 2, 1918, *Carter* (G); Wellington, *Carter 597* (G); along old water course, Wellington, *Carter 100* (G); Nanaimo, July 19, 1891, *Cooley* (G); near Victoria, May 1885, *Fletcher* (G).

Var. *hirtus* (Greene), comb. nov. *Allocarya hirta* Greene, *Pittonia* 1:161 (1888). *A. Scouleri* var. *hirta* Nelson & Macbride, *Bot. Gaz.* 61:36 (1916). *A. calycosa* Piper, *Contr. U. S. Nat. Herb.* 22:101 (1920).

Pubescence spreading, not strigose; mature calyx ca. 5 mm. long; nutlets 1.5-2 mm. long; style surpassing mature nutlets.

Known only from the type collection.

OREGON: Umpqua Valley, June 25, 1887, *Howell* (ND, TYPE of *A. hirta*; G, frag.); Umpqua Valley, June 25, 1887, *Howell* (Eug, TYPE of *A. calycosa*; G, frag.)

Var. *corallicarpus* (Piper), comb. nov. *Allocarya corallicarpa* Piper, *Proc. Biol. Soc. Wash.* 37:93 (1924).

Differing from species only in fruit; nutlets covered with conspicuously narrow high ridges and papillae and so more or less irregularly and deeply alveolate.

Southwestern Oregon.

OREGON: Medford, Jackson Co., *Piper* 5022 (G); Grants Pass, Josephine Co., *Heller* 10026 (UC); Grants Pass, *Piper* 5021 (US, TYPE; G, ISOTYPE).

The type of *Myosotis Scouleri* was collected by Scouler on the lower Columbia River. It has never had an adequate description, the diagnosis upon which it stands being scarcely more than a note in passing. The present application of the name has become the traditional one through Gray's use of it for this concept. I am by no means certain, however, that Gray's use of the name was ever checked by a critical examination of the type. Consequently the name may really belong to another species, to *P. granulatus* or even to a species of *Cryptantha*.

In its prevailing geminate and ebracteate racemes of conspicuous flowers the present plant is clearly set off from all other North American *Allocaryas*. Its relations are evidently with those species of similar habit found in south central Chile. Throughout its range it is a well marked species and in addition to the characters of its inflorescence can be readily separated from associated species by its large corollas and small solid distinctly lateral nutlet-attachment.

The varieties *hirtus* and *corallicarpus* are rather distinctive and it is possible they may be found to merit specific rank. At present, however, because of their occurrence within the general range of true *P. Scouleri*, because of the few collections extant and because of their very clear and decided relations with *P. Scouleri*, I have felt that they had best be treated as varieties. The material of both of these varieties in common with the southern Oregon material of the species tends to have the attachment-scar more or less surrounded by a ridge in the pericarp. The more northern collections of *P. Scouleri* quite lack this ridge or have it only partially represented in a short curved transverse ridge between the scar and the base of the nutlet.

Piper's *A. calycosa* seems to be merely a phase of the var. *hirtus*. In fact *A. calycosa* and *A. hirta* appear to have been based on different parts of a single collection by Howell. The two specimens do differ slightly in the character of the surface of the nutlet but such minor variations are not at all uncommon within a colony of an *Allocarya* species. As it now

stands, therefore, the var. *hirtus* appears to rest merely upon a single collection. It must be treated consequently as only tentative and further collections of it must be forthcoming before we can decide whether it is more than a mere strain represented by a single colony of plants.

The var. *corallicarpus* is a distinctive plant and of the two varieties of *P. Scouleri* is clearly the one most worthy of recognition. It is characterized by the high narrow ridging on its nutlets. Though the extreme southern material of *P. Scouleri* does tend to have more pronounced ridging on its nutlets than does that from further north I have not seen any material of the species which might be counted as actually transitional to the var. *corallicarpus*. I am of the belief, however, that thorough collecting in southern Oregon will show that these transitions do exist.

18. **Plagiobothrys Parishii** Johnston, Contr. Gray Herb. 68: 78 (1923). *Eritrichium Cooperi* Gray, Proc. Amer. Acad. 19:89 (1883). *Krynitzkia Cooperi* Gray, Proc. Amer. Acad. 20:267 (1885). *Allocarya Cooperi* Greene, Pittonia 1:19 (1887). Not *P. Cooperi* Gray (1883).

Annual, prostrate, hispidulous with short stout pallid spreading hairs, branched at the base; stems 5-30 cm. long; leaves slightly succulent, somewhat pustulate and hispidulous beneath, lower ones linear, 3-6 cm. long, 1.5-2 mm. broad, upper ones linear-oblong to oblong-oblong, 2-4 mm. broad; racemes slender and elongate, bearing a few bracts below the middle; mature calyx tending to be deciduous, hispidulous, accrescent; lobes loosely ascending, herbaceous, ligulate to lance-oblong or lanceolate, 2-3 mm. long, 0.5-1 mm. broad, 1½ to 2 times length of nutlets; pedicels slender, spreading, usually ca. 1 mm. long but the lowermost occasionally up to 12 mm. long; corolla conspicuous, white with a yellow throat, 3-5 mm. broad, surpassing the calyx 1-2 mm.; style about reaching middle of nutlets; nutlets 1.1-1.8 mm. long, more or less asymmetric, ovate to more or less broadly lanceolate, tending to be somewhat heteromorphic with the axial nutlet firmly affixed and frequently slightly larger and plumper than the other 3 nutlets and tending to be dull (rather than glossy) with granulations or muriculations; dorsum medially keeled only

near apex, with strong transverse ridges that are more or less broken up into tuberculations towards the base of the nutlet, frequently tuberculate between the ridges, with evident lateral keels; venter of axial nutlet with an oblique triangular-ovate scar when torn from gynobase, venter of other nutlets with a linear or cuneate or narrowly oblong scar seated in a groove bounded by roughly paralleling ridges in the pericarp; ventral keel folded over above the scar and at times practically in a groove formed by ventral ridges; scar $1/5$ - $1/6$ length of nutlet, suprabasal, oblique or distinctly lateral, closed and the attachment along a knife-like ridge or open and narrow with high erect or inbent margins and so deeply concave.

Western Mohave Desert and Owens Valley, Calif.; local.

CALIFORNIA: Lovejoy Springs, Los Angeles Co., April 1917, *Shaw, Spaulding & Walton* 993 (Pomona, Stan); along and in water, Rabbit Springs, San Bernardino Co., May 1882, *Parish* 1317 (G); carpeting wet mud in rather alkaline soil moistened by run-off from Rabbit Springs, June 10, 1930, *Johnston* 3769 (G); Mohave River, Camp Cady, San Bernardino Co., June 2, 1861, *Cooper* (G, TYPE); springs, Alabama Hills, Owens Valley, Inyo Co., *Austin* 457 (UC); between Bishop and Laws, Inyo Co., May 1913, *K. Brandegee* (UC).

A very well marked species especially notable for having its calyces tending to be deciduous at maturity. Its relationships are not clear but probably lie with some of the Great Basin species.

19. ***Plagiobothrys salsus*** (Brändeg.) Johnston, Contr. Gray Herb. 68:78 (1923). *Allocarya salsa* Brandegee, Bot. Gaz. 27:452 (1899). *A. Cusickii* var. *salsa* Brand in Engler, Pflanzenr. iv-252² (Heft 97):176 (1931). *A. jucunda* Piper, Bull. Torr. Bot. Cl. 29:643 (1902). *A. Cusickii* var. *jucunda* Nelson & Macbride, Bot. Gaz. 61:36 (1916).

Annual, ascending or prostrate or at times erect particularly when young, branched near base, with slender spreading pallid hairs; stems 6-18 cm. long, branching towards the base; leaves somewhat succulent, sparsely pustulate and setose beneath but less so above; lower leaves linear, 3-9 cm. long, 1.5-2 mm. broad; upper leaves lanceolate to oblanceolate, 2-3.5 mm. broad; racemes loose or dense, much bracted; mature calyx much accrescent, coarse, hispid, the base becoming enlarged, silicious and strongly ribbed; lobes herbaceous, 2.5-4 mm. long, 0.5-1 mm. broad, lanceolate to oblong-linear, spreading; pedi-

cels 0-1 mm. long, ascending; corolla 2-5 mm. broad, not much surpassing calyx; style not reaching quite to middle of nutlets; nutlets lanceolate, more or less asymmetric, 2-2.5 mm. long, axial one most firmly affixed; dorsum medially keeled near apex, mostly with a few sinuous low frequently anastomosing transverse ridges above the middle or these obscure and broken, below the middle more or less low-tuberculate, lateral keels present; venter with keel folded over near base; scar situated on the strongly oblique base of nutlet, in the axial nutlet (torn from the gynobase) ovate and open, in the other nutlets smaller cuneate to oblong or ovate with the margins erect or even inbent, hence more or less hollowed out and at times almost covered, $1/6$ - $1/8$ length of nutlet, not surrounded by a ridge in the pericarp.

Southern Nevada and southern Oregon; rare.

NEVADA: margin of streams, Caliente, Lincoln Co., *Goodding* 934 (G); alkaline soil, Twin Springs, central Nye Co., *Purpus* 6339 (UC, TYPE of *A. salsa*; G, frag.); Humboldt Wells, Elko Co., July 25, 1893, *Greene* (NY).

OREGON: in alkaline soil, margin of Christmas Lake, Lake Co., *Cusick* 2723 (G, TYPE of *A. jucunda*); by soda springs in marsh at upper end of Summer Lake, Lake Co., *Ferris & Duthie* 367 (Stan).

Obviously related to *P. Cusickii* from which it differs only in its spreading pubescence, larger corollas, broader and more spreading calyx-lobes and generally larger and more sharply lanceolate nutlets. It grows with its relative in southern Oregon. The type of *A. salsa* is a stout prostrate plant with crowded leaves and flowers that suggest it probably grew with a minimum of moisture in very alkaline soil. In any case I am convinced it is only an ecological form of the more erect and loosely branched forms I have placed with it.

20. ***Plagiobothrys lamprocarpus*** (Piper), comb. nov. *Allo-carya lamprocarpa* Piper, Proc. Biol. Soc. Wash. 37:94 (1924).

Annual, erect, 1-3 dm. tall, slender, strigose or appressed-1-2 dm. tall; stems simple, finely strigose; leaves linear, 1-2 cm. long, pustulate and appressed hispidulous beneath, nearly glabrous above; racemes unilateral, slender, bracted only towards base; mature calyx weakly accrescent, setulose, base thickened; lobes narrowly lanceolate, 1-2 mm. long, erect or strictly ascending, only shortly surpassing the nutlets; pedicels

0-0.7 mm. long, strict; corolla minute, 1-1.5 mm. broad; style not reaching middle of nutlet; nutlets solitary, ca. 1.6 mm. long, 1 mm. broad, glossy, broadly ovate and tending to be plano-convex, apex somewhat contracted and incurving; dorsum convex, broadly keeled at least to middle and with broad low transverse ridges and irregular tumulose roughenings; venter with a coarse erect medial keel the lower half of which is seated in a deep open groove in the thick pericarp; lowermost 1/5 of nutlet slightly oblique and flattened, bearing the small concave triangular-ovate sessile scar.

Known only from the type-locality.

OREGON: in moist places in an old road, Grants Pass, Josephine Co., *Piper* 5023 (US, TYPE; G, ISOTYPE).

A local species with a very peculiar nutlet. This is glossy with the strongly convex back broadly and indefinitely rugose and tumulose. The flattened venter of the body has a pronounced medial groove in which the coarse erect keel is distinctly placed. The lower 1/5 of the venter is flattened and slightly oblique forming a transversely elongate areola with low irregular tumid margins. Piper has placed this species in the "*sulcata*-group," i. e., with *P. Chorisianus*, *P. undulatus*, *P. lithocaryus* and *P. reticulatus*, but I am inclined rather to place it near *P. cognatus*.

21. **Plagiobothrys granulatus** (Piper), comb. nov. *Allo-carya granulata* Piper, Contr. U. S. Nat. Herb. 22:109 (1920). *A. fragilis* Brand in Fedde, Rep. Spec. Nov. 18:312 (1922).

Annual, erect, 1-3 dm. tall, slender, strigose or appressed-hispidulous, strictly to ascendingly branched; branches loosely disposed, usually several or more, springing from towards base of plant, elongate, usually rebranched; leaves appressed-hispidulous and more or less pustulate especially beneath, upper surface at times nearly glabrous; lower leaves linear, 3-7 cm. long, 1.5-2.5 mm. broad, loosely disposed; upper leaves linear to oblance-linear, tending to be somewhat broader than the lower ones; racemes slender, rather closely flowered, solitary or at times almost geminate, with lowermost 1-2 flowers bracted; pedicels 0.5-1 mm. long, strict or ascending; mature calyx weakly accrescent, generally appressed-hispidulous with the tips usually distinctly ferruginous; lobes 2.5-3 mm. long, narrowly lance-linear to linear, erect or even somewhat con-

nivent or ascending, almost twice length of nutlets; corolla evident, 2-3.5 mm. broad, surpassing calyx 0.5-1 mm.; style reaching to beyond middle of nutlet; nutlets ovate to lance-ovate, 1.2-1.7 mm. long; dorsum convex, medially keeled and with a few somewhat dentate transverse ridges above the middle, finely granulate, tuberculate or even somewhat papillate with the apices of the protuberances bearing broad conic cusps or murications; venter broadly angulate; base dorso-ventrally rounded or somewhat oblique and bearing supra-basally the substipitate scar; scar small, ovate, oblique to lateral, not immediately surrounded by a ridge in the pericarp or rarely with a falcate ridge just behind it.

Willamette Valley, Oregon, and southwestern Washington.

OREGON: west of Corvallis, Benton Co., June 2, 1915, *Owen* (Corv); moist ground near Corvallis, *Peck* 13724 (G); low ground near Salem, Marion Co., May 20, 1916, *Nelson* (G); ditch by roadside a mile east of Salem, *Nelson* 2192 (G); dried mud, State Fair Grounds, Salem, *Nelson* 1338 (G, TYPE of *A. granulata*) and 3088 (G); border of swamp, Orville, Marion Co., *Nelson* 1827 (G); stream bank 7 mi. west of Table Rock, Clackamas Co., *Peck* 13217 (G).

WASHINGTON: about shallow ponds, Bingen, Klickitat Co., *Suksdorf* 2207 (G, ISOTYPE of *A. fragilis*); meadows, Elma, Gray Harbour Co., May 1918, *Grant* (G); Puyallup, Pierce Co., *Piper* 5001 (G).

The relations of this species are obscure. Possibly it is a derivative of *P. medius*, which also occurs west of the Cascades but further north in northwestern Washington and on Vancouver Island. It tends to have similar ferruginous tips to the calyx-lobes, but differs in its sparsely bracted, more slender and more dense racemes, smaller corollas, shorter pedicels, smaller more granulate nutlets and smaller substipitate scar quite unsurrounded by ridges. The racemes in *P. granulatus* show a tendency to be geminate as in *P. Scouleri*, but I do not believe these species are closely related.

22. **Plagiobothrys medius** (Piper), comb. nov. *Allocarya media* Piper, Contr. U. S. Nat. Herb. 22:107 (1920). *A. divaricata* Piper, l. c. 107 (1920).

Annual, branched at base, strigose; stems 1-3 dm. long, erect or sometimes loosely ascending, slender; leaves strigose beneath, sparsely strigose or glabrous above; lower leaves linear 2-5(-12) cm. long, 1.5-2.5(-4) mm. broad; upper leaves linear to oblanceolate; racemes simple, loosely flowered, sub-

secund, bracted to the middle or even beyond; mature calyx appressed-hispidulous, the tips usually quite ferruginous when young; lobes lance-linear, 3-4(-5) mm. long, half again to about twice length of nutlets, erect or ascending; pedicels about 1 mm. long, the lowermost occasionally becoming 5-10 mm. long, erect or ascending; corolla 2.5-5 mm. broad; style reaching to about middle of nutlets; nutlets ovate or lance-ovate, usually rather plump, 1.5-2.3 mm. long, ca. 1 mm. broad, pericarp not very thick, finely granulate; dorsum keeled towards apex, the ridges evident to obscure, more or less oblique and frequently somewhat loosely anastomosing, not crowded, towards the base more or less replaced by tuberculations, interspaces usually sparsely tuberculate; venter keeled to near base, the keel occasionally in a weak groove formed by attendant ridges; scar small, ovate to elliptical, the edges spreading or ascending, lateral and barely suprabasal or on the oblique basal sixth of nutlet, usually somewhat prominent, with or without attendant ridges or wrinkles in the pericarp.

Vancouver Island and adjacent parts of Washington.

WASHINGTON: Port Angeles, Clallam Co., June 27, 1908, *Flett* 3378 (US, TYPE of *A. media*; G, frag.); Friday Harbor, San Juan Islands, *Zeller* 856 (G); without locality, 1889, *Vasey* 423 (G); Olympic Mts., Clallam Co., *Elmer* 2755 (ND).

BRITISH COLUMBIA (Vancouver Isl.): exposed rocks on seashore, Victoria, June 6, 1905, *Palmer* (US, TYPE of *A. divaricata*; G, frag.); vicinity of Victoria, 1893, *Macoun* (G); Victoria, May 18, 1917, *Newcombe* (G); in ditches near Victoria, May 1885, *Fletcher* (G); Nanaimo, July 8, 1917, *Carter* (G); Alberni, 1915, 1916 and 1917, *Carter* (G); dried out holes in old clearing, Alberni, *Carter* 592 (G); Sprout Lake Falls, 1916 and 1917, *Carter* (G); road to Cowichan Lake, *Rosendahl* 1759 (G); in ditches and wet places, Vancouver Isl., 1887, *Macoun* 56 (G); Vancouver Isl., 1858, *Lyall* (G).

In various details *P. medius* suggests affinities with *P. cognatus*, *P. granulatus* and *P. reticulatus*. Its immediate relationships, however, are not evident.

23. **Plagiobothrys cognatus** (Greene), comb. nov. *Allo-carya cognata* Greene, *Pittonia* 4:235 (1901). *A. microcalyx* Brand in Fedde, Rep. Spec. Nov. 19:71 (1923). *A. filicaulis* Brand, l. c. 72 (1923).

Annual, erect to spreading, usually branched at base; stems 5-25 cm. long, slender, strigose or with a fine appressed pu-

bescence; leaves pustulate and strigose beneath, much less so or even nearly glabrous above; lower leaves linear, 2-7 cm. long, 1.5-3 mm. broad, upper leaves linear or somewhat spathulate-linear; racemes solitary, slender, usually loosely flowered, with bracts throughout or only below middle; mature calyx more or less appressed-hispidulous, accrescent; lobes linear to narrowly lanceolate, 2-4 mm. long, 0.3-1 mm. broad, erect or loosely ascending, becoming as much as twice length of nutlets; pedicels 0.5-1 mm. long, ascending; corolla 1-2 mm. broad; style reaching to around middle of nutlet or beyond; nutlets broadly ovate to oblong-ovate, somewhat asymmetric, 1.3-2.2 mm. long, 0.6-1.1 mm. broad, tending to be broadly rounded or obtuse at base; dorsum keeled near apex and rarely down to middle of nutlet, tuberculate and with irregular ridges, the latter frequently more or less broken and sinuous, low and rounded or well defined, at times papillate-dentate, surface usually finely granulate, mostly pale and dull, at times somewhat glossy; venter with the keel usually folded over near base, lower $1/4$ - $1/6$ of nutlet rather broadly flattened or oblique and bearing the scar; scar expanded, broadly triangular to ovate, convex to concave, margin spreading; scar surrounded by ridges forming a very broad transversely elongate angular areola or this somewhat obscure; axial nutlet most firmly affixed and usually with a broader and flatter scar than in other nutlets.

Chiefly intermontane, ranging from eastern Washington, the eastern borders of California and northern Arizona into the Rocky Mountain area; also in Alaska where perhaps introduced.

ARIZONA: vicinity of Flagstaff, Coconino Co., Aug. 1915, *Hitchcock* (US, G); Fort Valley northwest of Flagstaff, July, 1927, *Fulton* (US, G).

NEVADA: Lee Post Office, S. Fk. Humboldt R., 5950 ft., *Heller 9435* (G); Humboldt Basin, 1872, *Gray* (G); Deeth, Elko Co., 5340 ft., *Heller 9019* in pt. (G).

CALIFORNIA: Hetch-Hetchy, July 7, 1897, *Congdon* (G); Soda Springs, Nevada Co., 7000 ft., *Jones 2428* (G, ISOTYPE of *A. filicaulis*); between Vinton and Beckwith, Plumas Co., *Heller & Kennedy 8680* (G, ISOTYPE of *A. microcalyx*); open places in yellow pine forest, Butte Meadows, Butte Co., 4200 ft., *Heller 12841* (G).

OREGON: Shirk, Harney Co., 5000 ft., *Leiberg 2591* (G); damp alkaline ground, Summer Lake, Lake Co., *Peck 15683* (G); wet meadows, Lake Co., *Peck 15293* (G); swampy meadow along Pelican Bay,

Upper Klamath Lake, Klamath Co., *Peck* 9508 (G); low ground, Lake-of-the-woods, Klamath Co., *Peck* 16508 (G); damp margin of Davia Lake, Deschutes Co., *Peck* 16951 (G).

WASHINGTON: Calispell Lake, Pend Oreille Co., *Kreager* 605 (G); without locality, 1889, *Vasey* 424 (G).

IDAHO: marshy sunny places, Falk's Store, Canyon Co., 2200 ft., *Macbride* 219 (G); open muddy spots in meadows, Corral, Camas Prairie, Blaine Co., 5700 ft., *Macbride & Payson* 2922 (G); mud flat at edge of pond, Rattlesnake Creek near Dixie, Elmore Co., 4000 ft., *Macbride & Payson* 2856 (G); in muddy places, St. Anthony, Fremont Co., *Merrill & Wilcox* 815 in pt. (G); dried up pond, Alpine Hot Springs, Bonneville Co., *Payson & Armstrong* 3414 (G).

Of this species I have cited material only from the six western states. The type of *A. cognata* was collected by Mulford at Cache Valley, Utah, in all probability at no great distance from Logan. It clearly represents the species with which we are here concerned. The present treatment of *P. cognatus*, however, must be considered at best merely tentative, for an intensive study of Rocky Mountain *Allocaryas* must precede any attempt to determine definitely its relations with *P. scopulorum*.

Much of the material I have placed in *P. cognatus* has been referred to *A. californica* by Piper in 1920 and to *P. scopulorum* by me in 1923. Piper, l. c. 111, has discussed the typification of *A. scopulorum* Greene and appears to have selected a collection by Greene, made in 1870 at Denver, as the type. This specimen is a form with dull, acute, distinctly lanceolate nutlets which differ from those of the Rocky Mountain material (Ft. Bridger, *Porter*; Lat. 39°-41°, *Hall & Harbour* 433) which Gray placed in his *Eritrichium californicum* var. *subglochidiatum* only in the lack of trichomes. As there is every evidence that such trichomes may be present or absent in the various species of *Allocarya* I am quite content to treat Greene's collection and Gray's specimens as conspecific and to accept Greene's collection as type. Such studies as I have made of *P. scopulorum* seem to indicate that the following names fall here as synonyms,—*A. Nelsonii* Greene, *P. Nelsonii* Johnston, *A. asperula* Piper, *A. lonchocarpa* Piper, and ?*A. asperula* var. *dacotica* Brand. I have seen material of *P. scopulorum* from Colorado, Wyoming, Montana, Saskatchewan and South Dakota. It clearly intergrades with *P. leptocladius*. It tends to have the stiffish stems and the asymmetric

calyx of that species, but differs in having a more or less supra-basal rather than a distinctly basal nutlet-attachment. It also intergrades, and apparently rather completely so, with *P. Cusickii* and *P. cognatus*, though usually its acute, lanceolate, dull, frequently trichome-bearing nutlets are sufficient to separate it. From these remarks it will be realized that the Rocky Mountain *Allocaryas* are most confusing and in much need of special study. Only such a study can determine whether *P. cognatus* deserves the specific rank I have provisionally accorded it.

Plagiobothrys cognatus is also related to *P. hispidulus*, the common and characteristic species of the high mountains of California. It appears to range with that species in eastern Oregon and Washington, in Idaho and northwestern Wyoming, and locally here and there in the northern and central Sierra Nevada. Typical *P. hispidulus* is, however, a reasonably well marked plant and one usually quickly recognizable once its characters are understood. It seems to be less variable than *P. cognatus* and is characterized by its rather stout, generally angulate nutlets which are usually distinctly granulate and frequently muriculate or short-hairy, and have the thick basal portion rounded off dorso-ventrally in a deeper more sweeping curve. The scar is also closely surrounded by a puckering up of the pericarp. This has produced definite wrinkles and ridges that define the circular or elongate areola occupied by the scar. The scar, the encircling ridge, and the erect ventral keel are practically in the same plane or closely paralleling planes. This strong puckering up of the pericarp about the scar of *P. hispidulus* seems to have lifted up the basal quarter of the nutlet and narrowed it. The nutlets are not broadly flattened across the base of the venter and are not more or less oblique there as is common in *P. cognatus*. The scar is never oblique.

Plagiobothrys cognatus and *P. hispidulus* are occasionally difficult to distinguish, particularly in Idaho, but generally speaking, the two are readily separable. Since they occupy the same region over parts of their areas of dispersal, the puzzling material may well be of hybrid origin. The few specimens of *P. cognatus* from the Sierra Nevada seem most likely to represent local incursions from the western margin of the

Great Basin. I suspect that *P. cognatus* will be found to be the prevailing if not the only one of these two species found on the lower eastern slopes of the Sierras.

24. **Plagiobothrys Cusickii** (Greene), comb. nov. *Allocarya Cusickii* Greene, Pittonia 1:17 (1887). (?) *A. setulosa* Piper, Contr. U. S. Nat. Herb. 22:93 (1920). *A. ambigens* Piper, l. c. 96 (1920). *A. insculpta* Piper, l. c. 109 (1920).

Annual, prostrate or ascending, rarely erect especially when young, branched at base; stems 5-20 cm. long, slender, with sparse fine more or less appressed hairs; leaves pustulate and having appressed hairs beneath, much less so above, margins frequently somewhat ciliolate; lower leaves linear, 3-10 cm. long, 1-2.5(-5) mm. broad, upper ones linear to lanceolate and 1-4 mm. broad; racemes solitary, usually slender, loose or dense, bracted at least below the middle and frequently throughout; mature calyx finely appressed-hispidulous, weakly accrescent; lobes linear or lance-linear, 1.5-4 mm. long, 0.3-1 mm. broad, erect or ascending, up to twice length of nutlets; pedicels 0.5-1 mm. long, slender, ascending; corolla 1-1.5 mm. broad, barely exerted; style reaching to about middle of nutlets; nutlets rather asymmetric, lanceolate to oblong-ovate, 1-2 mm. long, 0.5-1 mm. broad, glossy, not granulate, usually abruptly angled or rounded at base; dorsum keeled near apex and rarely on down towards middle, with irregular more or less oblique ridges, in the interspaces and towards the base tuberculate, roughenings usually low and rounded and at times even rather obscure; venter keeled to well beyond middle (lower part of keel folded over to one side), lower $1/4$ - $1/6$ oblique and bearing the deep small scar; scar on homomorphic nutlets cuneate to oblong or linear, with thin erect or infolding projecting margins, seated in a simple depression or rarely more or less enclosed in an areola defined by ridges; axial nutlet firmly attached, with a broad flat ovate or deltoid scar.

Eastern Washington, eastern Oregon (where apparently common) and the eastern borders of California, to Idaho and southern Nevada.

NEVADA: alkali ground, St. Thomas, Clark Co., Goodding 697 (G); Palisades, Eureka Co., Aug. 24, 1896, Greene (ND); Soda Springs, Esmeralda Co., June 1882, Shockley 322 (ND); Eagle Valley, Ormsby

Co., *Baker* 1266 (G); Carson City, Ormsby Co., 1865, *Anderson* 197 (G); Reno, Washoe Co., 1884, *Curran* (G, ND, UC);

CALIFORNIA: between Vinton and Beckwith, Plumas Co., July 2, 1907, *Heller & Kennedy* 8682 (G, TYPE of *A. ambigens*); alkaline soil, Susanville, Lassen Co., June 13, 1918, *McKee & Westover* (G).

OREGON: wet ground along Alvord Lake, Harney Co., *Peck* 14018 (G); wet ground 2 mi. east of Burns, Harney Co., *Peck* 14289 (G); margin of Christmas Lake, Lake Co., *Cusick* 2724 (G); wet shore of Summer Lake, Lake Co., *Eggleston* 6795 (NY); near hot springs, Lakeview, Lake Co., *Peck* 15361 (G); wet ground 8 mi. west of Lakeview, Lake Co., *Peck* 15242 (G); near Fort Klamath, Klamath Co., *Leiberg* 659 (US, TYPE of *A. setulosa*; G, ISOTYPE); damp alkaline ground, Klamath Falls, *Peck* 9434 and 9436 (G); in alkali soil, Hot Lake, Union Co., *Piper* 5010 (G); Hot Lake, June 1927, *Sherwood* 421 (G); "Malheur Region, Union Co., Ore., 1883, *Cusick*" (UC, ?authentic *A. Cusickii*).

WASHINGTON: borders of alkaline swales, Coulee City, Douglas Co., June 1, 1902, *Piper* 3869 (US, TYPE of *A. insculpta*; G, frag.).

IDAHO: moist subsaline soil, Salmon, Lemhi Co., 4500 ft., *Payson* 1776 (G).

The type of *A. Cusickii* has not been examined. Since neither Piper nor I could find it in the Greene Herbarium or in any of the other herbaria we visited, it seems likely that it has been lost. I suspect that it may have been a part of the California Academy herbarium and so destroyed in the San Francisco fire of 1906. The basis of *A. Cusickii* was given by Greene as follows.—"Union County, Oregon, 1883, W. C. Cusick, also at Reno, Nevada, 1884, Mrs. Curran." At Berkeley there is a sheet from the Brandegee herbarium bearing two small pockets which Mrs. Brandegee has labeled as representing *A. Cusickii*. One of the pockets contains fragments labeled as from Reno and collected by Curran. The other contains fragments labeled as from,—"Malheur Region, Union Co., 1883, *Cusick*." Mrs. Brandegee obtained many critical fragments of Greene's species of *Boraginaceae*. The two pockets at Berkeley represent, I believe, fragments of the original specimens upon which Greene based his *A. Cusickii*. The material in the two pockets is evidently conspecific and is well covered by Greene's original description. It evidently represents the plant I have described above. The fragment from Cusick, despite its contradictory geographic data, may well be accepted as authentic.

The species has obvious relatives in *P. nitens* and *P. salsus* and intergrades badly with *P. cognatus* and *P. scopulorum*. Its

outstanding characters are its glossy nutlets and the knife-like projecting edges of its attachment-scar. The scar is elongate and frequently sunken in the pericarp. Its edges are thin and usually ascending, erect or inflexed.

Allocarya ambigens seems quite like ordinary *P. Cusickii*. *Allocarya insculpta* may be slightly more granulate and hence not quite so glossy but seems practically inseparable. *Allocarya setulosa* is a curious form with the nutlets plump and abundantly tuberculate. It is more dull than glossy but, despite this and its other differences, really belongs in this relationship. It is at most only a minor form.

25. **Plagiobothrys nitens** (Greene) Johnston, Contr. Gray Herb. 68:78 (1923). *Allocarya nitens* Greene, Pittonia 3:108 (1896).

Annual, erect or diffuse, usually slender and loosely branched below the middle, lower internodes usually developing; stems 5-20 cm. long, sparsely strigose; leaves sparsely short-ciliate, the faces sparsely strigose; lower leaves linear or subulate-linear, 2-5 cm. long, 1-2.5 mm. broad; upper leaves linear or lance-linear; racemes usually slender, bracted throughout, solitary, becoming loosely flowered; mature calyx finely appressed-hispidulous, weakly accrescent; lobes linear or lance-linear, 1.5-3 mm. long, 0.3-0.6 mm. broad, erect or ascending, as long or half again as long as the nutlets; pedicels 0.5-1 mm. long, slender, ascending; corolla inconspicuous, ca. 1 mm. broad, barely exerted; style reaching to about middle of nutlets; nutlets lance-ovate, asymmetric, 1-1.9 mm. long, apparently smooth and shiny but under a high magnification minutely granulate and with very obscure low ridges and tuberculations; dorsum rounded or flattened, not keeled; venter smooth, with a strong medial keel to well below middle, the keel folded over below middle; scar on slightly oblique basal portion of nutlet in more or less of an elongate depression in the pericarp, cuneate to triangular, with narrow thin erect or infolding margins; axial nutlet most firmly attached and perhaps slightly the largest, the attachment somewhat larger than in the other nutlets and not depressed.

Northeastern Nevada; rare.

NEVADA: Pine Creek, Eureka Co., July 20, 1896, *Greene* (ND,

TYPE; G, frag.); Deeth, Elko Co., July 17, 1908, *Heller 9019* (G, in pt.).

This species is known only from northeastern Nevada where, to judge from mixed collections, it apparently grows with *P. cognatus*. Its relations, however, are clearly with *P. Cusickii* of which it may be only a variation with smooth rather than roughened nutlets. Its smooth nutlets at once set it off from all its congeners except the very distantly related *P. lithocaryus* of the North Coast Ranges of California.

26. **Plagiobothrys tener** (Greene), comb. nov. *Allocarya tenera* Greene, *Pittonia* 3:109 (1896). *A. gracilis* Piper, *Contr. U. S. Nat. Herb.* 22:98 (1920). *A. laxa* Piper, l. c. 98 (1920). *A. pratensis* Piper, l. c. 99 (1920). *A. vallata* Piper, l. c. 101 (1920). *A. scalpocarpa* Piper l. c. 111 (1920).

Annual, slender, 1-3 dm. tall, erect or occasionally somewhat decumbent, becoming strictly or ascendingly branched, usually simple near base; stems sparsely strigulose or sparsely appressed-hispidulous; leaves sparsely appressed-hispidulous and pustulate at least so on the under surface; lower leaves usually linear, 2-6 cm. long, 1-2 mm. broad, rarely becoming oblance-linear and as much as 4 mm. broad; racemes slender, usually loosely flowered, bractless or occasionally with a bract at the very base; mature calyx strigose or appressed-hispidulous and usually sparsely so, with some tawny hairs, somewhat accrescent, the turbinate or conic base tending to be well developed; lobes narrowly lanceolate to linear, 2-3.5 mm. long, barely surpassing the nutlets to almost twice their length, usually ascending but rarely widely spreading; pedicels 0.7-2 mm. long, erect or ascending; corolla conspicuous, 3-7 mm. but usually 5-6 mm. broad; nutlets lance-ovate, 1.5-2.2 mm. long, slightly incurved; dorsum rather rounded, somewhat keeled towards apex, granulate and tuberculate, commonly with some strong narrow obliquely transverse papillate-dentate ridges or these broken up into more or less prominent papillae or tuberculations, the interspaces narrow and irregular, the surface usually muricate or with short microscopic hairs, lateral keels very weak; venter as in *P. hispidulus*.

Inner side of the North Coast Ranges of California, northward into Shasta and Modoc counties.

CALIFORNIA: wet soil at head of Moores Creek, Howell Mt. east of

Angwins, Napa Co., *Tracy* 1538 (UC); Adams Springs, Lake Co., July 1894, *Booth* (ND, TYPE of *A. tenera*; G, frag.); Goose Valley, Shasta Co., *Eastwood* 718 (Cac, TYPE of *A. vallata*; G, frag.); Goose Valley, *Eastwood* 747 (G); in wet meadows, Deer Flat, Shasta Co., *Hall & Babcock* 4276 (UC, TYPE of *A. gracilis*; G, frag.); meadows near Bear Creek, Shasta Co., *Hall & Babcock* 4162 (UC, TYPE of *A. pratensis*; G, frag.); wet place along stream near Redding, Shasta Co., *Heller* 7908 (G); Burney, Shasta Co., *Eastwood* (Cac, TYPE of *A. scalpocarpa*; G, frag.); Shasta, July 1886, *Morse* (UC); south side of Mt. Shasta, Siskiyou Co., *Brown* 590 (US, TYPE of *A. laxa*; G, frag.); low wet ground, Modoc Co., 1893, *Baker* (UC); Taylor Creek flat, Forestdale, Modoc Co., *Nutting* (UC).

Var. **subglaber**, var. nov. Planta subsucculenta sparsissime strigosa vel subglabra; calycibus strictis, lobis conniventibus erectis; corolla 3 mm. lata.

Known only from about the type-locality.

CALIFORNIA: open gravelly places in Yellow Pine belt in valley of a tributary of Cache Creek 5 mi. east of Houghs Springs, Lake Co., May 10, 1919, *Heller* 1349a (G, TYPE); 4 to 5 mi. east of Houghs Springs, May 7, 1928, *Abrams* 12569 (NY).

Var. **fallax**, var. nov. Nuculae in faciebus ventralibus ad basim versus obliquae, cicatrici obliqua suprabasali vix laterali ornatae.

Known only from the type-locality.

CALIFORNIA: Prattville, Plumas Co., June 1878, *Austin* (G, TYPE).

A well marked species with a slender erect habit, usually inconspicuous pubescence, comparatively large corollas and practically naked racemes. Its nutlets are very suggestive of those of *P. hispidulus* and probably indicate the relationships of the species. They permit *P. tener* to be readily separated from *P. glyptocarpus* and *P. strictus*, the only other large flowered species of northern California.

The nutlets vary from finely granulate to muriculate and even minutely bristly. The type of *P. tener* has nutlets with low short irregular ridges and with the interspaces low verrucose and short-bristly. In the type of *A. vallata* the ridges on the nutlets are reduced to a row of tuberculations, the surface of the fruit is finely granular-muriculate. The type of *A. laxa* has nutlets with prominent papillae and short bristles. Practically the same is to be found in the type of *A. pratensis*, the chief difference being that some incomplete ridges are developed. The type of *A. gracilis* has nutlets slightly broader in

proportion than the above and has more regular and distant transverse ridging. Its surface is densely and finely granulate. My examination of the type of *A. gracilis* revealed none of the bristles on the fruit mentioned by Piper, l. c. 84. What is more the nutlets were all provided with a definite dorsal keel which extended to the middle and frequently even to the base. Piper says "keeled near apex." The type of *A. scalpocarpa* seems to be a form with ridged nutlets. No bristles or murications are developed on its surface.

The var. *subglaber* is a form with nutlets like those in the species. Its smooth somewhat succulent habit, however, suggests a small form of *P. stipitatus*. Its erect firm calyx-lobes are peculiar. The var. *fallax* is a form with the habit of *P. tener* but with the nutlets of *P. bracteatus*, the attachment being borne on the oblique base and hence not distinctly lateral as in typical *P. tener*.

27. **Plagiobothrys bracteatus** (Howell), comb. nov. *Allo-carya bracteata* Howell, Fl. N. W. Amer. 1:481 (1901). *A. Leibergii* Piper, Contr. U. S. Nat. Herb. 22:95 (1920). *A. conjuncta* Piper, l. c. 109. *A. commixta* Brand in Fedde, Rep. Spec. Nov. 18:312 (1922). *A. Piperi* Brand, l. c. 19:70 (1923). *A. Hillebrandii* Brand, l. c. 71 (1923). *A. californica* var. *debilis* Greene ex Baker, West Amer. Pl. 2:7 (1903), nomen. *A. charaxata* var. *debilis* Brand, in Engler, Pflanzenr. iv-252² (Heft 97):165 (1931). *A. debilis* Greene ex Brand, l. c. 165 (1931), in synonymy.

Annual, sparsely and rather inconspicuously strigose, slender, usually with long branches from the base; stems 1-4 dm. long, commonly ascending but at times erect or decumbent; lower leaves 4-10 mm. long, 1.5-3(-4) mm. broad, linear; upper leaves usually linear, rarely oblong or oblance-oblong; racemes slender and elongate, bracted towards base; mature calyx more or less accrescent; lobes linear to lanceolate, 2-4 mm. long, barely surpassing to slightly more than twice length of fruit, ascending; pedicels mostly 1 mm. long, strictly ascending, the lowermost rarely 3-10 mm. long; corolla 1-3 mm. broad, only slightly surpassing the calyx; style reaching 1/2 to 2/3 height of nutlets; nutlets 1.2-2 mm. long, 0.8-1.2 mm. broad, oblong-ovate; dorsum somewhat keeled above middle, granulate, with

irregular more or less oblique transverse wrinkles or ridges, ridges below middle tending to become broken and more or less replaced by tuberculations, ridges not roughened, interspaces narrow and sparsely if at all tuberculate; venter keeled and angulate to well beyond middle, lower $1/5$ - $1/4$ puckered up to form a ridge surrounding the scar; scar small, oblique or at times almost basal, narrowly ovate or elliptical to cuneate, concave.

From northernmost Lower California, northward through California into southwestern Oregon; common in central California.

LOWER CALIFORNIA: northern part, April 6, 1886, *Orcutt* 2259 (UC).

CALIFORNIA: between Miramar and La Jolla, San Diego Co., April 15, 1903, *Brandeggee* (UC); 3 mi. east of Templeton, San Luis Obispo Co., May 9, 1926, *Wiggins* 2074 (Stan); between Emmet and Panoche Pass, San Benito Co., 1921, *Abrams & Borthwick* 79231 (Stan); southern Monterey County, 1886, *Hickman* (G); ditches and low fields, Stanford University, Santa Clara Co., *Baker* 401 (G); moist depressions near Campbell, Santa Clara Co., *Heller* 8512 (G); Mt. Hamilton, Santa Clara Co., *Elmer* 2231 (NY); Park Ranch, Mt. Hamilton Range, *Heller* 8911 (G, ISOTYPE of *A. commixta*); Mt. Eden, Alameda Co., May 22, 1893, *K. Brandeggee* (UC); Oakland, Alameda Co., May 13, 1882, *Jones* (G); Livermore, Alameda Co., *Heller* 7321 (G); Farallon Islands, April 18, 1919, *Rixford* (CAc); Glen Ellen, Sonoma Co., *Baker* 629 (UC); near Wright School, Sonoma Co., *Baker* 3586 (G, UC); dry vernal pool along Bennett Valley road near Summit, Sonoma Co., *Baker* 2143a (G, UC); Petaluma, Sonoma Co., *Eastwood* 10482 (G); Willits, Mendocino Co., *Piper* 5197 in pt. (G); Potter Valley, Mendocino Co., June 1899, *Purpus* (UC); Potter Valley, *Eastwood* 12631 (CAc); rain pools, Glenville, Greenhorn Range, Kern Co., 3200 ft., *Howell* 5146 (G); Blochman's Ranch, Mariposa Co., *Eastwood* 4307 (G); Agua Fria, Mariposa Co., May 1, 1898, *Congdon* 9449 (G); Mariposa, May 16, 1897, *Congdon* 47 (G); near Knights Ferry, Stanislaus Co., *Abrams* 10087 (NY); Antioch, Contra Costa Co., May 1884, *K. Brandeggee* (UC); Suisun, Solano Co., *Eastwood* 10430 (G); moist low ground near Folsom, Sacramento Co., *Heller* 12306 (G); Calistoga, Napa Co., May 8, 1900, *Eastwood* (G); St. Helena, Napa Co., May 2, 1897, *Jepson* (G); near Napa, *Heller & Brown* 5361 (G, ISOTYPE of *A. Piperi*); in depressions, Davis, Yolo Co., *Hall* 11240 (G); Boggs Lake, Bottle Rock Mt., Lake Co., June 30, 1911, *K. Brandeggee* (UC); Houghs Springs, Lake Co., *Abrams* 12532 in pt. (NY); 2 mi. south of Arbuckle, Colusa Co., *Abrams* 12592 (NY); dry ditch bed, Chico, Butte Co., *Copeland* in Baker dist. no. 3046 (G, ISOTYPES of *A. conjuncta* and *A. debilis*); moist soil near Mosquito Creek in yellow pine belt between

Appleton and Coutelence, Butte Co., *Heller 13180* (G); low places in adobe 8 mi. west of Orland, Butte Co., *Heller 11838* (G); Crescent Mills, Plumas Co., *Eastwood 14446* (NY).

OREGON: Medford, Jackson Co., *Piper 5013* (G); Medford, *Leiberg 4120* (US, TYPE of *A. Leibergii*; G, frag.); near Wimer, Jackson Co., *Hammond 292* (NY); bank of Rogue River near Savage Rapid, Josephine Co., *Peck 14960* (G); south bank of Rogue River 5 mi. east of Grants Pass, Josephine Co., *Peck 779* (G); 5 mi. above Gold Beach, Curry Co., *Peck 14646* (G); Canyonville, Douglas Co., *Peck 14931* (G); Oakland, Douglas Co., *Peck 7870* (Salem).

Var. *aculeolatus* (Piper), comb. nov. *Allocarya aculeolata* Piper, Proc. Biol. Soc. Wash. 37:94 (1924).

Nutlets with the dorsal keel and ridges bearing minute apically barbed trichomes; trichomes scattered, solitary or clustered.

Known only from the type-locality.

CALIFORNIA: dried mud-hole on a ridge 10 mi. east of Chico, Butte Co., *Piper 5020* (US, TYPE; G, ISOTYPE).

A common species at low altitudes in central California and apparently the one which has chiefly passed as *Allocarya californica* in the writings of Greene and Jepson. The oldest name for the plant, however, seems to be *A. bracteata* Howell. That species was based upon material found "In wet places, Umpqua Valley Douglas Co. Oregon" by Howell. The type, unfortunately, appears to have been lost. Though Piper and I have seen all the American collections in which it could be expected, neither of us could find it. What is more no isotype has been discovered. The only species known from the Umpqua and Rogue River valleys, which drain southwestern Oregon, are *P. Greenei*, *P. stipitatus*, *P. hispidulus*, *P. reticulatus*, *P. Scouleri*, *P. glyptocarpus* and the present species. Of these only *A. Scouleri* and the present plant are known from the Umpqua Valley. Since the original description of *A. bracteata* fits our plant and clearly excludes the several species mentioned, I am confident that the name *A. bracteata* Howell is, in fact, properly applicable to the species with which we are here concerned.

The next name applicable to this concept is *Allocarya Leibergii* Piper. It was based upon a type collected by Leiberg at Medford, Jackson Co., Oregon, and is a form with the nutlet-attachment nearly basal. It is notable, however, that Piper has collected specimens (no. 5013) at Medford which have the habit of Leiberg's plant but which differ in having the attach-

ment-scar more or less oblique and suprabasal. This collection Piper has distributed as representing his *A. Leibergii*. From this it is clear that Piper evidently considered the type of his *A. Leibergii* as an extreme form in its nutlet-attachment. With this I am in full agreement. The other collections of *P. bracteatus* from southern Oregon have oblique nutlet-attachment quite similar to that prevailing in the common Californian representatives of the species.

The form of the species in the Sacramento Valley of California is similar to that of Oregon. It is, however, generally more strict and seems to have narrower less conspicuous leaves than the material from the coastal slopes of California south of San Francisco Bay. To this latter coastal form belong the names *A. commixta*, *A. Piperi* and *A. Hillebrandii*. I have not seen authentic collections of the last species. It was based upon a collection from the Oakland Hills made in 1863 by Hillebrand. The original description, fortunately, leaves little doubt as to its identity. The Sacramento Valley form has been described under the names *A. conjuncta* and *A. charaxata* var. *debilis*. These names, in fact, are based upon different specimens of the same collection.

The relations of *P. bracteatus* are very evident. In the Great Valley of California it intergrades with *P. stipitatus* var. *micranthus* and in Sonoma County intergrades with *P. reticulatus* var. *rossianorum*. Generally, however, it is readily recognizable and for convenience, if for no other reasons, I believe it should be treated as a species distinct. Its oblique scar usually separates it readily from *P. stipitatus*. In not having the ventral keel in a distinct groove on the nutlet it is commonly quickly distinguished from *P. reticulatus*. It does not frequent such humid locations as *P. reticulatus* nor so saline locations as *P. stipitatus*.

The variety *aculeolatus* is prostrate and more evidently strigose than is common in *P. bracteatus*. The trichomes on the nutlets suggest those frequent on the fruit of *P. hispidulus*, but its strongly oblique nutlet-attachment and its valley habitat show more affinity with *P. bracteatus*.

28. **Plagiobothrys hispidulus** (Greene), comb. nov. *Allo-carya hispidula* Greene, Pittonia 1:17 (1887). *A. penicillata*

Greene, l. c. 18 (1887). *A. hispidula* var. *penicillata* Jepson, Man. Fl. Pl. Calif. 853 (1925). *A. cryocarpa* Piper, Contr. U. S. Nat. Herb. 22:98 (1920). *A. cervina* Piper, l. c. 100 (1920). *A. ramosa* Piper, l. c. 100 (1920). *A. nigra* Brand in Fedde, Rep. Spec. Nov. 19:71 (1923).

Annual, grayish green, usually becoming branched at the base with the stems prostrate or loosely ascending, rarely simple below and becoming ascendingly branched and 5-15 cm. tall; stems strigose, 5-40 cm. long; leaves appressed-hispidulous and somewhat pustulate, the upper face less so or even glabrous; lower leaves linear, 1-5 cm. long, 1-2.5 mm. broad; upper leaves linear to oblanceolate; racemes usually elongate and loosely flowered, single, leafy bracted especially towards base; mature calyx more or less accrescent, strigose or appressed-hispidulous; lobes linear to narrowly lanceolate, 1.7-3 mm. long, 0.2-0.6 mm. broad, acute, ascending, barely surpassing to slightly more than twice length of nutlets; pedicels slender, mostly 0.5-1 mm. long but frequently the lower ones slightly longer and exceptionally the lowermost becoming even 5-10 mm. in length; corolla inconspicuous, surpassing the calyx 0-1 mm., limb 1-2 mm. broad; style reaching to $\frac{1}{2}$ to $\frac{3}{4}$ height of nutlets; nutlets 1.5-2 mm. long, ovate to lance-ovate, base usually abruptly rounded and somewhat angulate; dorsum keeled some above middle, more or less abundantly and obliquely transverse-ridged, the ridges frequently broken and anastomosing, the interspaces tuberculate and usually granular, the keels and ridges (particularly on axial nutlet) frequently dentate with papillae and usually granular or muriculate or bearing minute hyaline more or less branched hairs; keeled laterally; venter keeled and angulate to below middle, lowermost quarter puckered up into a ridge encircling the scar and sloping off precipitously at the base and rapidly at the sides, the ridge lying in or even slightly above the plane of the erect ventral keel; scar linear-oblong to elliptical or narrowly obovate, lateral, suprabasal, small, usually concave.

Mountain valleys of southern California, the Sierra Nevada and the higher North Coast Ranges of California, northward in eastern Oregon and Washington and eastward through Idaho to northwestern Wyoming.

CALIFORNIA: moist shore of Cuyamaca Lake, San Diego Co.,

Abrams 3845 and *Munz & Harwood* 7191 (G); rather dry disturbed soil at edge of meadow, Bluff Lake, San Bernadino Mts., San Bernardino Co., *Munz* 10604 (G); Talmidges Mill, San Bernardino Mts., *Parish* 3239 (ND); Seeleys Flat, San Bernardino Mts., *Parish* 2433 (G); edge of Bear Lake, San Bernardino Mts., *Parish* 1470 (G, ISOTYPE of *A. hispidula*); wet soil, Bear Valley, *Parish* 3247 (G); Long Meadow, Tulare Co., *Palmer* 190 (NY); Pine Ridge, Fresno Co., *Hall & Chandler* 282 (NY); Tioga Road, Mariposa Co., June 8, 1897, *Congdon* 46 (G); Yosemite Valley, Mariposa Co., *Abrams* 4613 (G); gravel soil of meadow, Sly Park, El Dorado Co., *Hall* 11314 (G); Fallen Leaf Lake, El Dorado Co., *Abrams* 4876 (G); Lake Valley, El Dorado Co., *Abrams* 4770 (G); near Lily Lake, Glen Alpine Region, El Dorado Co., *Eastwood* 875 (Cac, TYPE of *A. cryocarpa*; G, frag.); sand about reservoir, Emigrant Pass, Placer Co., *Heller* 12877 (G); Truckee, Nevada Co., June 27, 1884, *Sonne* (G); Boca, Nevada Co., July 24, 1895, *Greene* (ND); one mile above Truckee on Truckee River, *Heller* 7055a (G, ISOTYPE of *A. nigra*); dry ground away from water, Donner Lake, Nevada Co., July 8, 1903, *Heller* (G); Donner Lake, Aug. 1883, *Greene* (ND, TYPE of *A. penicillata*; G, ISOTYPE); lake shore, Donner Lake, *Heller* 6891 and *Hall* 11393 (G); Sierra County, *Lemmon* 492 (G); Chico Meadows, yellow pine belt, Butte Co., *Heller* 11496 and 11969 (G); near Redding, Shasta Co., *Heller* 7891 (US, TYPE of *A. cervina*; G, ISOTYPE); Burney, Shasta Co., June 28, 1912, *Eastwood* (G); Fall River Springs, northwestern Shasta Co., *Hall & Babcock* 4184 (G); Comptons Prairie, north base of Mt. Eddy, Siskiyou Co., *Heller* 13264 (G); damp land near Yreka, Siskiyou Co., *Butler* 1424 (G); Sherwood Valley, Mendocino Co., May 29, 1899, *Davy & Blasdale* 1057 (UC).

NEVADA: Carson City, Ormsby Co., 1865, *Anderson* 197a (G).

OREGON: Ashland, Jackson Co., *Piper* 5017 (G); wet grassy places at summit of Siskiyou Mts., Josephine Co., *Heller* 13632 (NY); along Willamette River 4 mi. above Independence, Polk Co., *Peck* 13702 (G); sandbar in Willamette River 3 mi. north of Sidney, Marion Co., *Nelson* 4638 (G); dry ground at Salmon River Meadows, 15 mi. south of Swim, Clackamas Co., *Thomson* 4929 (G); wet ground, summit of Cascades along Ashland-Klamath Falls road, Klamath Co., *Peck* 9273 (G); damp ground, Keno, Klamath Co., *Peck* 9329 (G); damp bank of Klamath River, Keno, *Peck* 9325 (G); moist ground 10 mi. east of Pinehurst, Klamath Co., *Peck* 15095 (G); moist slope 6 mi. south of Lake-in-the-Woods, Klamath Co., *Peck* 16660 (G); near hot springs, Lakeview, Lake Co., *Peck* 15360 (G); near Crooked River by Pineville, Harney Co., *Leiberg* 318 (US, TYPE of *A. ramosa*; G, ISOTYPE); wet soil, Stinking Water, Harney Co., *Leiberg* 2346 (G); summit of Steen Mt. near source of Wild Horse Creek, Harney Co., *Peck* 14025 (G); damp meadow, Tumalo, Deschutes Co., June 21, 1921, *Whited* 366 (G); along river, Laidlow, Deschutes Co., June 19, 1921, *Whited* 366 (G); 4 mi. below Strawberry Lake, Grant Co., *Peck* 10301 (NY); moist ground,

Austin, Grant Co., *Henderson* 5203 (G); bottoms of John Day River, Humphry's Ranch, Grant Co., *Henderson* 5202 (G); wet meadow, Dalles, Wasco Co., *Lunell* 72 (G); boggy ground near Pendleton, Umatilla Co., *Henderson* 89 (G); moist ground, Meacham, Umatilla Co., *Peck* 2958 (G); sulphurous soil, Hot Lake, Union Co., *Piper* 5019 (G).

WASHINGTON: damp low ground, Falcon Valley, Klickitat Co., *Suksdorf* 2113 (G); damp ground north of Ellensburg, Kittitas Co., *Whited* 654 (G); damp ground north of Ellensburg, *Thompson* 8370 (G); along streams, Waitsburg, Walla Walla Co., 1897, *Horner* (G); Blue Mts., Columbia Co., 1897, *Horner* (G); Harrington, Lincoln Co., *Sandberg & Leiber* 217 (G).

IDAHO: dry slopes, Tamarack, Washington Co., *Clark* 210 (G); grassy lowlands, House Creek, Owyhee Co., *Nelson & Macbride* 1805 (G); damp slopes, Boulder Creek, Owyhee Co., *Macbride* 517 (G); damp soil along river, St. Anthony, Fremont Co., *Merrill & Wilcox* 832 (G); in muddy places, St. Anthony, *Merrill & Wilcox* 815 in pt. (G).

WYOMING: Norris, Yellowstone Park, *Nelson* 6136 (G); Canyon Hotel, Yellowstone Park, 1922, *Hawkins* (G).

This plant is the common *Allocarya* of the pine belt in the California mountains and in the valleys of eastern Oregon. It is closely related and habitally very similar to *P. cognatus* and cannot be sharply separated from that species. A study of a large mass of material, however, will show that these two species do have different types of nutlets and in the main do have different ranges. The western forms of *P. cognatus* do not have strongly granulate or hairy nutlets, so that in material from Oregon and California this development in *P. hispidulus* aids greatly in distinguishing that plant.

The type of *A. penicillata* is a very thrifty form having the nutlets armed along the ridges and on the tuberculations with very short stiff bristles. The type of *A. cervina* and *A. ramosa* have more elongate, less rigid, frequently branched trichomes on the nutlets. In the types of *A. hispidula* and *A. cryocarpa* the trichomes are reduced to muriculations. In the type of *A. nigra* the trichomes are quite absent, the nutlet surface being merely finely and densely granulate. These names, consequently, cover the full range of trichome development, a gamut of variation frequently covered in various degrees among plants of a single collection.

29. **Plagiobothrys trachycarpus** (Gray) Johnston, Contr. Gray Herb. 68:78 (1923). *Krynitzkia trachycarpa* Gray,

Proc. Amer. Acad. 20:266 (1885). *Allocarya trachycarpa* Greene, Pittonia 1:14 (1887). *A. interrasilis* Piper, Contr. U. S. Nat. Herb. 22:108 (1920). *A. brachycarpa* Greene ex Ind. Kew. suppl. 1:19 (1901), lapsu calami. *Krynitzkia brachycarpa* Gray ex Ind. Kew. l. c. (1901), lapsu calami.

Annual, becoming laxly ascending or prostrate, strigose or appressed-hispidulous, much branched at the base; stems 5-45 cm. long, usually with elongate ascending branches; lowermost leaves linear, obtuse, 5-10 cm. long, 1.5-3 mm. wide; upper leaves oblanceolate to linear-oblanceolate, 2-5 mm. broad; racemes becoming very loosely flowered, bracted throughout with foliaceous bracts placed mostly between the flowers; mature calyx strigose, more or less distinctly accrescent; lobes linear to lance-linear, 3-5 mm. long, herbaceous, $1\frac{1}{2}$ to 3 times length of fruit, strictly ascending to more or less distinctly spreading, usually with tawny hairs at tip; pedicels 0.5-1 mm. long, ascending; corolla not conspicuous, scarcely surpassing the calyx, limb 1-2.5 mm. broad; style reaching to beyond middle of nutlet; nutlets ovate and rather angulate, 1.8-2 mm. long, 1-1.3 mm. broad; dorsum with a distinct keel to the middle and frequently beyond, with more or less parallel transverse ridges and rather distinct lateral keels, these commonly strong and narrow and frequently tuberculate or papillate-dentate, surface granulate, interspaces usually broad and tuberculate; venter obtusely angled with a strong ventral keel, lower $\frac{1}{4}$ to $\frac{1}{5}$ occupied by the expanded scar; scar distinctly lateral, suprabasal, broad, much expanded, ovate or deltoid, concave, closely surrounded by a strong ridge the forward ends of which may prolong forward as ridges appressed to the base of the ventral keel.

Inner South Coast Ranges of California south to San Benito County and in the drier coastal valleys from Monterey to Los Angeles county.

CALIFORNIA: Gardena, Los Angeles Co., May 15, 1902, *Braunton* 303 (G); in desiccated pond near Gardena, March 20, 1897, *McClatchie* 1348 (G); Inglewood, Los Angeles Co., April 1899, *Abrams* 319 (G, Stan); damp grassy flat, Morro Creek, San Luis Obispo Co., *Munz* 9211 (G); Carmel Valley, a mile above the Mission, Monterey Co., *Abrams* 6414 (NY); foot of San Juan Grade, Monterey Co., *Abrams* 5649 (NY); Paicines, San Benito Co., *Howell* 4581 (CAc); Hollister,

San Benito Co., April 14, 1897, *Setchell* (UC, TYPE of *A. interrasilis*; G, frag.); Livermore Valley, Alameda Co., April 3, 1895, *Greene* (ND); Livermore, April 1892, *Bioletti* (G); damp places, Walnut Creek, Contra Costa Co., April 30, 1862, *Brewer 1007* in pt. (G, TYPE of *K. trachycarpa*); Antioch, Contra Costa Co., April 7, 1895, *Greene* (ND); Byron Springs, Contra Costa Co., March 1889, *Greene* (ND); Tracy, San Joaquin Co., April 1889, *K. Brandegees* (UC); San Joaquin Valley, April 21, 1884, *Greene* (G).

The original description of *Krynitzkia trachycarpa* Gray was based upon two collections cited "California in Sonoma Co., *Brewer*, and San Joaquin Valley, *Greene*." *Greene's* plant is a slender but quite typical plant of this species. The *Brewer* collection is a mixture consisting of a large branch of the present plant and two small branches of *P. bracteatus*. These latter are relatively large flowered and it is evidently from them that Gray got the maximum in his measurement of the corolla ("lin. 1-2 lato"). In his description of the nutlets as "late ovato-trigonis rugis crebris reticulatis," the diagnosis clearly applies to the larger branch with small flowers collected by *Brewer* and to the specimens from the San Joaquin Valley made by *Greene*. It is this material that I consider as typical of *K. trachycarpa*. The right-hand plant on the sheet of *Brewer 1007* in the Gray Herbarium, I consider as type of the species.

The locality "Sonoma Co." given for *Brewer 1007*, the type of *P. trachycarpus*, seems to be a clerical error. That geographic designation is written on the *Brewer* label in Gray's script. A study of *Brewer's* original field-books, now a part of the library at the Gray Herbarium, shows that *Brewer 1006* was collected April 30, 1862, in Walnut Creek in west-central Contra Costa County, California. As *Brewer* gives his no. 1006 as doubtfully a *Myosotis* and states that it grows in damp places and has a white corolla with a yellow center, it seems evident that the data in the note book do properly apply to the specimens in question. The type locality "Walnut Creek" would bring it into the area in which the plant has been most repeatedly collected and in which reports indicate it as not uncommon. On the other hand no collections of *P. trachycarpus* are known to me from north of San Francisco Bay, let alone from Sonoma County.

The species seems to merit the universal recognition ac-

corded it since it was first proposed over forty-five years ago. It is, however, difficult to describe and key out satisfactorily. For clarity, therefore, it seems well to enumerate its salient characters,—Plant diffuse, the racemes bracted throughout; nutlets ovate, rather angular, with strong keels and usually strong loosely arranged ridges, not at all muriculate or setose, pericarp thick and bony and frequently glossy; scar distinctly lateral, expanded, surrounded by a strong ridge. Piper's *Allocarya interrasilis* is merely a form with strong rounded rather than prominent ridges.

Through some parts of its range the species grows with *P. bracteatus* which is readily distinguished by its more erect or ascending habit, less abundantly bracted racemes and its lance-ovate nutlets with close-set obliquely transverse wrinkle-like ridges and small more or less distinctly oblique basal attachment. It seems, however, much more closely related to *P. diffusus* of San Francisco and along with this questionably distinct form probably finds its most marked affinities in *P. reticulatus* of the coastal slopes north of San Francisco Bay. There is a distinct tendency in *P. trachycarpus* for the development of ridges paralleling the ventral keel, a character well developed in *P. reticulatus*. The nutlets of *P. trachycarpus*, however, differ from those of *P. reticulatus* in having strong more or less transverse (rather than weak reticulate) ridges, in being distinctly and generously tuberculate, and in having a conspicuously thicker and firmer pericarp.

30. **Plagiobothrys diffusus** (Greene), comb. nov. *Allocarya diffusus* Greene, Pittonia 1:14 (1887).

Differs from *P. trachycarpus* only in its nutlets, these being broadly ovate, 1.3-1.5 mm. long, 1 mm. broad; dorsum conspicuously convex, keeled to middle or beyond, ridges rather irregular and more or less reticulately joined, the interspaces small and distinctly tuberculate, granulate; venter with the strong ridge surrounding the scar distinctly prolonged forward along the keel, the latter hence apparently in a groove up at least to the middle of the nutlet; scar lateral with the expanded margin strongly upturned and hence narrow and deeply convex.

Known only from about the type-locality.

CALIFORNIA: U. S. Marine Hospital, San Francisco, May 27, 1887,

Greene (ND, TYPE; G, frag.); Presidio Hills, San Francisco, May 1, 1887, *Greene* (NY); San Francisco, April 1886, *Greene* (G).

Quite like *P. trachycarpus* except for its nutlets which differ in shape, size and roughenings; these smaller, proportionally thicker and broader and less angulate, having a weaker dorsal keel, weaker fewer irregular more or less reticulate ridges, and provided with evident ridges attending the lower end of the ventral keel.

According to *Greene* the type came from grassy places about the Marine Hospital in the Presidio at San Francisco. The species remains known from that locality only. The slopes overlooking the Golden Gate on which it grows are influenced by the sea and are much more moist than the warm interior bases and slopes of the Coast Ranges to which *P. trachycarpus* is restricted in central California. The habitat of *P. diffusus* is similar, however, to that of *P. reticulatus* which ranges in the moist coastal slopes north of San Francisco Bay.

31. ***Plagiobothrys reticulatus*** (Piper), comb. nov. *Allo-carya reticulata* Piper, Contr. U. S. Nat. Herb. 22:105 (1920). *A. minuta* var. *reticulata* Jepson, Man. Fl. Pl. Calif. 852 (1925). *A. minuta* Piper, l. c. 104 (1920). Not *P. minutus* Johnston (1924). *A. areolata* Piper, l. c. 105 (1920). *A. dispar* Piper, l. c. 109 (1920).

Annual, more or less strigose, grayish or yellowish green, usually much branched at the base; stems erect to decumbent, 1-5 dm. long; leaves appressed-hispidulous; lower leaves linear to spathulate-linear, 3-8 cm. long, 2-3.5(-4) mm. broad; upper leaves tending to be linear-oblong or lance-oblong; racemes slender, single, elongate, loosely flowered, leafy bracted towards base; mature calyx more or less accrescent, appressed-hispidulous; lobes linear to lanceolate, acute, ascending, 2.5-4 mm. long, half again to twice length of fruit; pedicels slender, mostly ca. 1 mm. long, ascending, lowermost occasionally much elongated and 3-10 mm. long; corolla 1.5-3.5 mm. broad; style reaching to about 3/4 height of nutlet; nutlets ovate, rather plump and with a thin pericarp, 0.7-1.7 mm. long, 0.5-0.9 mm. broad, finely and rather sparsely granulate; dorsum convex, keeled only near apex, ridges low and rounded and irregularly anastomosing, tuberculations absent or sparse and rather

obscure; venter strongly keeled; scar small, narrowly elliptic to ovate, concave; ridge surrounding scar in the plane of the ventral keel or somewhat downwardly oblique to it, the ends characteristically prolonged forward forming distinct ridges which parallel and are slightly but distinctly separated from either side of it and so cause the keel to lie seemingly in a broad open smooth trough up to about the middle of the nutlet.

Coastal valleys of northern California and southern Oregon.

CALIFORNIA: Mendocino, Aug. 3, 1882, *Pringle* (US, TYPE of *A. areolata*; G, frag.); Eureka, Humboldt Co., *Piper* 5011 (G); abundant in winter pools, Eureka, *Tracy* 2111 (UC); Humboldt Bay, *Chandler* 1172 (G); White Thorn Valley, Humboldt Co., *Tracy* 5010 (UC); Holmes Flat, along Eel River between South Fork and Scotia, Humboldt Co., *Tracy* 4691 (UC, TYPE of *A. reticulata*; G, frag.); abundant in wet places, Ft. Steward, Humboldt Co., *Tracy* 4469 (UC, TYPE of *A. minuta*; G, frag.).

OREGON: moist ground east of Gold Beach, Curry Co., *Leach* 1510 (G); barnyard in dry soil, Agness, Curry Co., *Nelson* 1433 (G, TYPE of *A. dispar*); damp slope, The Heads, Port Oxford, Curry Co., *Peck* 9060 (G); damp ground along Cedar Fork 5 mi. above Euchre Creek, Curry Co., *Peck* 14650 (G); moist sunny rill, Coos Bay Life Saving Station, Coos Co., *Henderson* 13774 (G).

Var. *rossianorum*, nom. nov. *Myosotis californica* Fischer & Meyer, Ind. Sem. Hort. Petrop. 2:42 (1835). *Eritrichium californicum* A. De Candolle, Prodr. 10:130 (1846). *Krynitzkia californica* Gray, Proc. Amer. Acad. 20:266 (1885). *Allo-carya californica* Greene, Pittonia 1:20 (1887); not *Plagiobothrys californicus* Greene (1887). *A. scalpta* Piper, Contr. U. S. Nat. Herb. 22:104 (1920).

Nutlets similar to those of *P. bracteatus* but having the ventral keel in an evident groove. Differs from *P. reticulatus* as follows,—Nutlets with firmer, less plump, more granulate pericarp, and tending to be oblong-ovate and hence slightly more elongate; dorsum transverse-rugose and more abundantly tuberculate; ventral keel in a narrower, less perfect and less pronounced groove.

Coastal slopes of northern California, generally more southern than the species, and with an outlying station in western Santa Barbara County.

CALIFORNIA: depressions on mesa 7 mi. north of Lompoc, Santa Barbara Co., May 18, 1932, *Hoffmann* 697 (G); Point Reyes, Marin Co., *Davy* 6814 (UC); Bodega Bay, Marin Co., June 1905, *K. Brandegee* (UC); [Fort Ross, Sonoma Co.] garden material from seed

received from Fischer and hort. Petrop. (G, authentic *M. californica*); Bodega Road, 4 mi. east of Valley Ford, Sonoma Co., *Howell* 5225 (G); Cazadero, Sonoma Co., *Congdon* 55 (G); in the "Horse Pasture" near summit of Mt. Sanhedrin, Lake Co., *Heller* 5929 (G); Willitts, Mendocino Co., *Piper* 5006 (G); Alder Point Flat on Eel River, Humboldt Co., *Tracy* 1878 (UC, TYPE of *A. scalpta*; G, frag.).

The type of *A. minuta* is peculiar because of its very small nutlets, these being 0.7 mm. long and 0.5 mm. broad. In this regard it is not characteristic of the species as here defined. I consider it, however, merely a nutrition or shade form of the species. The nutlets of *P. reticulatus* are characteristically plump and ovoid. The pericarp is notably thin and its surface is very sparsely and finely granulate. The ridging on the nutlets is low and loosely reticulate. If at all present, the tuberculations are only low and few. The ridge surrounding the scar is prolonged forward on either side of the ventral keel forming a distinct open groove in which the keel appears to be seated. These characters are evident in all forms referred to typical *P. reticulatus*, including the type. Piper's *Allocarya reticulata* and *A. areolata* represent the common, normal forms of the species. Their author distinguished them by the amount of granulation on the nutlets. A comparison of the types, however, proves this difference very illusive.

The Californian material I have placed under *P. reticulatus* is more erect in growth and tends to have a less conspicuously pubescent more yellowish green herbage than that from Oregon. The type of *A. dispar*, which comes from Oregon, has nutlets quite similar to those of *A. reticulata* and *A. areolata*. It differs, however, in having a slightly firmer pericarp and in showing more of a tendency to be tuberculate. The other collections from Oregon, however, have nutlets much more like those of the California plants.

I have seen a slightly immature collection from Blasdale's, Sherwood Valley, Mendocino Co., Calif., collected May 29, 1899, by Davy and Blasdale (no. 1056 at UC.), which appears to be a form of *P. reticulatus* with the nutlets minutely bristly. Further collections of this form are needed. It may merit nomenclatorial recognition.

In Sonoma County and in the interior of Humboldt and Mendocino counties typical *P. reticulatus* intergrades with var. *rossianorum*. This variety in its turn is confluent with *P. brac-*

teatus. In addition to this clear cut series of affinities, the species also suggests relationships with *P. diffusus* and *P. Chorisianus*. The latter species, of course, has nutlets with the ventral keel in a much more highly developed groove and has, as well, a knife-like nutlet-attachment. Our species is further suggestive of *P. Chorisianus* in its thin pericarp and the frequent development of very elongate pedicels.

Nomenclatorially the var. *rossianorum* is identical with *Myosotis californica* of Fischer & Meyer (= *Allocarya californica* Greene) which was founded upon material collected by the Russians near Fort Ross, Sonoma Co., California. It represents the southern form of *P. reticulatus* which tends strongly to have nutlets similar to those of *P. bracteatus*. Intergrades connect it completely with both *P. reticulatus* and with *P. bracteatus*, more completely so, however, with the former. From *P. bracteatus* it differs in having the ventral keel seated in an open groove formed by forward prolongations of the ridge surrounding the scar. That this difference is not completely arbitrary is indicated by the fact that the plants with this groove all come from west of the North Coast Ranges.

UNIDENTIFIED AND EXCLUDED NAMES

Allocarya dichotoma Brand in Fedde, Rep. Spec. Nov. 18:313 (1922).—CRYPTANTHA HENDERSONI (Nels.) Piper.

Allocarya Hendersoni Nelson, Erythea 7:69 (1899).—CRYPTANTHA HENDERSONI (Nels.) Piper.

Allocarya plebeja (Cham.) Greene, Pittonia 1:16 (1887).—This name and its synonyms under *Eritrichium* and *Krynitzkia* have been applied to various of our plants from the coastal area from middle California northward. The records from western United States, however, are all based on misdeterminations. The name is properly applicable only to the plant of Kamchatka, the Aleutian Islands, Alaska and possibly Vancouver Island. Recent studies have shown that it is a synonym of *P. orientalis* (L.) Johnston, Contr. Gray Herb. 81:80 (1928).

Allocarya propinqua Greene ex Baker, West Amer. Pl. 2:7 (1903).—This name, unaccompanied by any description, appears in C. F. Baker's plant-list. It is associated with speci-

men no. 3207 of Baker's distributions which, as abbreviations indicate, was collected in western middle California. I have been unable to find a specimen bearing this number and am consequently quite unable to place this *nomen subnudum*.

II. NOTES ON VARIOUS BORAGES OF THE WESTERN UNITED STATES

Heliotropium convolvulaceum (Nutt.) Gray, var. ***californicum*** (Greene), comb. nov. *H. californicum* Greene, Bull. Calif. Acad. 1:202 (1885). *Euploca aurea* Rose & Standley, Contr. U. S. Nat. Herb. 16:16, t. 11 (1912).

This plant of the deserts of California, western Arizona and northern Sonora is distinguished from the more eastern typical form of the species by its rougher, more spreading and pungent indument. Typical *H. convolvulaceum* has decidedly strigose stems and leaves.

Mertensia arizonica Greene, var. ***Leonardi*** (Rydb.), comb. nov. *M. Leonardi* Rydberg, Bull. Torr. Bot. Cl. 36:680 (1909). (?) *M. Sampsonii* Tidestrom, Proc. Biol. Soc. Wash. 26:122 (1913).

This is the form of *M. arizonica* from northern Utah, distinguished by Macbride, Contr. Gray Herb. 48:9 (1916), as *M. arizonica* var. *umbratilis* (Greenm.) Macbr. A close study of *M. umbratilis* Greenm. has shown, however, that this name, and hence the varietal combination based upon it, must be restricted to a plant of Oregon and Washington clearly separated from *M. arizonica* by differences in corolla-structures and a large hiatus in range. The corolla of *M. arizonica* has a tube scarcely if at all longer than the throat and is very hairy within. The corolla-tube of *M. umbratilis* is distinctly longer, even twice as long as the throat, and is quite glabrous within. *Mertensia umbratilis* appears to be a distinct species with its nearest relative in the probably synonymous *M. infirma* Piper. Hence it is that the northern form of *M. arizonica*, characterized by having the calyx-lobes as long or longer than the calyx-tube, is without a valid varietal name. Macbride, l. c., cited as synonyms of the variety, *M. intermedia* Rydb. and *M. stenoloba* Greene. This was a mistake, for a study of types proves these to be forms of *M. foliosa* Nelson. The first available name for our northern plant is *M. Leonardi* Rydb. It should be added that I have seen no material of *M. arizonica*,

in any of its forms, north or east of Utah. The collections so determined seem to be all forms of *M. foliosa*.

Mertensia foliosa Nelson, Bull. Torr. Bot. Cl. 26:243 (May, 1899). *M. tubiflora* Rydberg, Bull. Torr. Bot. Cl. 26:544 (Oct. 1899). *M. intermedia* Rydberg, Mem. N. Y. Bot. Gard. 1:335 (1900). *M. stenoloba* Greene, Pl. Baker. 3:20 (Nov. 18, 1901). *M. symphytoides* Greene, l. c. 20 (1901). *M. nutans* Howell, Fl. N. W. Amer. 491 (Nov. 20, 1901). *M. coronata* Nelson, Bull. Torr. Bot. Cl. 29:403 (1902). *M. nevadensis* Nelson, Proc. Biol. Soc. Wash. 17:96 (1904). *M. foliosa* var. *nevadensis* Macbride, Contr. Gray Herb. 48:19 (1916).

The species concerned here ranges from east central Washington to northeastern California and eastward to northern Utah and middle western Montana. In this area it is that common *Mertensia* in which the stems are tufted and spring from among the old stocks and petioles that crown a dense erect multicapital caudex. The corolla-tube varies from abundantly pilose inside to quite glabrous. The faces of the leaves are glabrous or practically so. There is considerable variation in response to environment. I am inclined to believe that perhaps *M. coriacea* Nelson, Bull. Torr. Bot. Cl. 29:402 (1902), and its var. *dilatata* Nelson, l. c. 403, should be referred here as an alpine phase. I have seen types and isotypes of all the species cited.

Mertensia foliosa* var. *subcalva (Piper) Macbride, Contr. Gray Herb. 48:18 (1916). *M. nutans* subsp. *subcalva* Piper, Contr. U. S. Nat. Herb. 11:479 (1906). *M. Bakeri* var. *subglabra* Macbride, l. c. 49:66 (1917).

Included in this variety are the phases of *M. foliosa* in which the upper surface of the leaves is strigose. It is sporadic throughout the range of the species. In its typical form it is a low plant, usually about 1.5 dm. tall, and has quite glabrous corollas. The common form of it in central Idaho, eastern Oregon and northeastern California is a more leafy plant, usually 2-3 dm. tall, having the corolla-tube usually hairy within. This form is Macbride's *M. Bakeri* var. *subglabra*. Though a minor form it is conspicuous and so for convenience may be recognized as ***M. foliosa* var. *subcalva* forma *Macbridei***, nom. nov.

Mertensia foliosa var. **amoena** (Nels.), comb. nov. *M. amoena* Nelson, Bot. Gaz. 30:195 (1900). *M. Bakeri* var. *amoena* Nelson, Man. Bot. Rocky Mt. 422 (1909). *M. Cusickii* Piper, Bull. Torr. Bot. Cl. 29:643 (1902). *M. pubescens* Piper, Contr. U. S. Nat. Herb. 11:479 (1906). *M. foliosa* var. *pubescens* Macbride, Contr. Gray Herb. 48:19 (1916). *M. eplicata* Macbride l. c. 16 (1916).

This phase of *M. foliosa* ranges from central Washington and northeastern California to southwestern Montana. Both surfaces of its leaves are covered with slender appressed hairs. The corolla-tube seem to be always more or less hairy within. The typical form of the variety is about 1-2 dm. tall. The forms of it found in central Idaho, eastern Oregon and adjacent California, however, are much more robust and noticeably more leafy. These have been described as *M. Cusickii* and *M. eplicata* and may here be designated as **M. foliosa** var. **amoena** forma **Cusickii** (Piper), comb. nov.

Mertensia paniculata (Aiton) Don var. **subcordata** (Greene) Macbride, Contr. Gray Herb. 48:7 (1916). *M. subcordata* Greene, Pittonia 4:89 (Dec. 1899). *M. platyphylla* Heller, Bull. Torr. Bot. Cl. 26:548 (Oct. 1899). *M. membranacea* Rydberg, Bull. Torr. Bot. Cl. 28:33 (1901). *M. laevigata* Piper, Contr. U. S. Nat. Herb. 11:477 (1906). *M. ambigua* Piper, l. c. 477 (1906). *M. brachycalyx* Piper, l. c. 477 (1906). *M. laevigata* var. *brachycalyx* Macbride, l. c. 10 (1916). *M. leptophylla* Piper, l. c. 478 (1906). *M. paniculata* var. *subcordata* forma *leptophylla* Macbride, l. c. 7 (1916). *M. pratensis* var. *borealis* Macbride, l. c. 8 (1916). *M. denticulata* of Piper, Fl. NW. Coast 301 (1915), not of G. Don.

The typical forms of true *M. paniculata* range from Quebec across Canada to Alaska and British Columbia. South of the International Boundary it is known only from northern Minnesota and Wisconsin and from the mountains of Montana and Idaho. It is a plant with the leaves hairy on both surfaces, the upper surfaces are characteristically scabrous. The calyx and pedicels are clothed with short spreading hairs. The inside of the corolla-tube is almost always hairy. In Washington, Oregon and Idaho there is a plant, the general habit and

structures of which show a close affinity with true *M. paniculata*. This plant, however, has the upper surfaces of the leaves quite glabrous and smooth or rarely muriculate-roughened or very shortly strigose. The pedicels are strigose or glabrous or rarely short-hairy. The corolla seems to average slightly smaller in size and to be very commonly glabrous within. In some extreme southern forms it is more slender and has a less expanded throat. This group of plants, of northwestern United States, is consequently much less hairy than the typical forms of *M. paniculata* which occur to the east and north. As none of the characters of the northwestern form are decisive and since obvious intergrades connecting it with *M. paniculata* are to be found in collections from northeastern Washington and northern Idaho, I have considered it as only varietally distinct from its northern relative. I am accepting as proper name for it, *M. paniculata* var. *subcordata*. A consideration of a large mass of material has convinced me that it is a practicable and natural variety worthy of the recognition here accorded it. As will be seen from the synonymy given above, however, it has been the subject of much segregation. This I believe has forced complication on what seems to be merely a simple geographic variation without aiding in convenience or precision or bringing any convincing evidence as to the fundamental phylogenetic homogeneity of the segregates proposed. The segregates seem to be neither practicable nor wholly natural. For the most part they appear to be trivial combinations of minor variations.

The material from western Oregon and Washington has the upper leaf-surfaces muriculate or somewhat scabrous. The pedicels, however, are strigose and the corolla-tube is mostly glabrous inside. This form is the basis of *M. subcordata* and *M. platyphylla*. *Mertensia laevigata* is a form with the leaves and pedicels practically glabrous. *Mertensia ambigua* and *M. brachycalyx* have practically glabrous leaves but strigose pedicels. *Mertensia leptophylla* has the pedicels with the spreading hairs of *M. paniculata* but has the upper leaf-surface glabrous. The lower surface of the leaves is hairy. *Mertensia pratensis* var. *borealis* and *M. membranacea* have strigose pedicels but leaves that are scabrid or short-strigose above. They represent forms transitional to *M. paniculata*. In short I have

referred to the variety *subcordata* all but two (nos. 1 and 5) of the first nine species given in Piper's Flora of Washington, as well as the material which Macbride, in his revision of the genus, referred to *M. paniculata* var. *subcordata*, *M. platyphylla*, *M. pratensis* var. *borealis* and *M. laevigata*.

Cryptantha humilis (Gray) Payson, Ann. Mo. Bot. Gard. 14:278 (1927). *Eritrichium glomeratum* var. *humile* Gray, Proc. Amer. Acad. 10:61 (1875). *Oreocarya humilis* Greene, Pittonia 3:112 (1896).

A few words are needed regarding the typification of this species. Payson (l. c.) gave Greene as the parenthetical authority for the name *Cryptantha humilis* and suggested that its type should be a specimen collected by Greene, on July 16, 1896, near Holborn, Nevada. With this procedure I cannot agree. When Greene published *Oreocarya humilis* he cited "*Eritrichium glomeratum*, var. *humile*, Gray, in part," gave an original description, and indicated the range of the species as "Frequent in the mountains of Nevada and adjacent eastern California." *Oreocarya humilis* has been accepted by all authors, except Payson, as being based upon Gray's variety *humile*. Originally very vaguely defined by Gray to cover a miscellany of plants from "Saskatchewan and along the higher Rocky Mountains and Sierras," the name var. *humile* was finally left by Gray (Proc. Amer. Acad. 20:279. 1885), as constituting the greater part of his newly published *Krynitzkia sericea*. Sierra Nevadan material he admitted to *K. sericea* only doubtfully. As neither Gray nor Greene were working in accord with the type-concept, Greene could and logically did restrict the var. *humile* to the otherwise unnamed plant of the Sierras and adjacent Nevada. In raising it to specific rank he clearly described this form. As this was the first attempt narrowly to restrict Gray's name and since Greene applied it to a form which Gray had left without precise placing, it is logical and in line with traditional usage to treat *Oreocarya humilis* as based upon the var. *humile* and to accept the precise delimitation of the variety given by Greene. Should a type be selected at this late date, however, it should be, not from Greene's herbarium, but from Gray's collections and consist of some specimen in that collection which came from Nevada or Cali-

fornia and was included in the var. *humile* as delimited by Greene. As Gray admitted no material from Nevada when the variety was originally published, the typification, of a consequence, must fall upon a specimen from the Sierras. In 1875 Gray had only one specimen of the variety from these mountains, a collection from Summit obtained in 1871 by Bolander. It is this specimen that I would consider as type of *Oreocarya* or *Cryptantha humilis*. The plant is somewhat immature. Payson, l. c. 291, identified it as "*humilis* or possibly *nubigena*," but its pedicellate flowers and simple cymes clearly place it in *O. humilis* as defined by Greene.

Payson cites *Eritrichium glomeratum* var. (?) *fulvocanescens*, Wats. Bot. King Exped. 243 (1871), as a synonym of *C. humilis*. This I believe is incorrect. Watson took a herbarium name of Gray's and described under it an aggregate species. When Gray finally published his name, *E. fulvocanescens* Gray, Proc. Amer. Acad. 10:61 (1875), he cited Watson's trinomial as an unqualified synonym and appears to have accepted the limits given it by Watson. Gray, hence, evidently thought them to be quite synonymous. It becomes clear therefore that if Payson is correct in his allocating of the name *E. glomeratum* var. *fulvocanescens*, the specific name *fulvocanescens* must be accepted in place of *C. humilis*. Watson, however, found Gray's name on a specimen from New Mexico collected by Fendler (no. 632). He accepted that specimen as belonging to his variety and indicated it as the source of his botanical name. He erred in taxonomic judgment, though, in placing with it certain material from Nevada and possibly Utah, that belongs at least in part to *C. humilis*. Payson has placed particular emphasis on these latter specimens. I believe, however, that since Watson included the Fendlerian New Mexican plant in his concept and indicated it as the source of his name that it should be taken as the type of *fulvocanescens*, both as variety and species. Consequently the name applies to a very different plant from that later described as *Oreocarya humilis* by Greene.

Cryptantha (§ OREOCARYA) **Thompsonii**, sp. nov., grisea caespitosa; caulibus pluribus erectis 1-2.5 dm. altis e radice valida crassa profunda dense multicapitali orientibus minute

adpresseque villosulis evidenter divaricateque setosis ad basim versus basibus petiolorum vetustorum abundantium crassissime vestitis; foliis basalibus oblanceolatis 3-7.5 mm. longis 4-12 mm. latis paullo supra medium ad basim versus in petiolum evidentem gradatim contractis griseo-tomentulosis pilis rigidis adpressis numerosis vix conspicue armatis, margine plus minusve ciliatis; foliis caulinis distantibus lineari-oblanceolatis viridioribus minus tomentulosis superioribus haud conspicue reductis; inflorescentia thyrsoida setosa apicem versus crassiori 2-4 cm. diametro; cymulis monochasialibus 3-7 flores (quorum saepe 3-5 fertiles) gerentibus laxis flexuosis bracteis foliosas paullo vel vix superantibus maturitate saepissime ca. 3 mm. longis ad apicem versus caulis capitato-congestis ceteris in axillas foliorum superiorum interrupte dispositis; lobis calycis anthesi 2-3 mm. longis tubo corollae subaequilongis linearibus, fructiferis 8-12 mm. longis lineari-lanceolatis setosis; pedicellis 1 mm. longis; corolla alba, tubo 3-4 mm. longo, limbo concavo 3-5 mm. diametro; nuculis subnitidis ovatis vel oblongo-ovatis breviter acuminatis dorso indistincte irregulariterque rugosis et tuberculatis ventre laevibus infra medium sulco aperto cuneiformi notatis.

WASHINGTON: rocky open crest of Iron Mt., Mt. Stuart region, Kittitas Co., 7000 ft., July 27-31, 1931, *J. W. Thompson 7663* (Gray Herb., TYPE); open slopes along Beverly Creek, below cliffs, Mt. Stuart region, Kittitas Co., 4000 ft., July 13, 1932, *Thompson 8742* (G); Washington Territory, 1883, *Brandege 996* (G); Yakima Region, July 1883, *Tweedy* (NY).

A very distinct species probably most closely related to *C. nubigena* (Greene) Payson of the mountains of California, Nevada, Oregon and Idaho, from which it differs in its stronger root, more erect habit, larger, more distinctly oblanceolate leaves, looser and larger thyrsoid inflorescence and different, more bracted cymes. In *C. nubigena* the cymes are dense, short, unilateral and scorpioid with the flowers distinctly two-ranked. In *C. Thompsonii* they are loose and flexuous with the flowers well separated and not unilateral or two-ranked. Brandege's collection cited above has been referred to *C. celo-sioides* by Piper and by Payson. Its small corollas, inflorescence, habit of growth and nutlets quickly separate it from that species.

Mr. Thompson has very kindly supplied me with notes re-

garding the habitat and associates of this remarkable species. His first collection (no. 7663) came from a colony of about a hundred plants growing in obsidian on the alpine crest of Iron Mountain. In habit the plants are loosely caespitose, springing from a large woody taproot which penetrates deep into the rocky soil. The associates are *Horkelia Tweedei* Nels. & Macbr., *Chaenactis nevadensis* Gray, *Campanula scabrella* Engelm., *Polystichum Lemmoni* Underw., *Claytonia megarhiza* Parry, and *Asplenium viride* Huds. The second collection (no. 8742), obtained the following year, was collected just across Beverly Creek from the original station, a distance less than a half mile. It occurred in the same alpine conditions but in broken talus below an obsidian cliff. A few feet from this second station was collected *Pellaea Breweri* Eaton, the second record for that species in Washington. An apparently new *Collomia* was also found nearby. Not far away was a grove of *Laxix Lyallii* Parl. *Cryptantha Thompsonii* is obviously one of a group of species localized in the Mt. Stuart region.

The species is named in honor of Mr. J. William Thompson of Seattle whose energetic collecting and most excellent specimens have given greatly increased facilities in recent years for the study of the flora of Washington. Since Mr. Thompson has shown a particular interest in the *Boraginaceae* and has been of great assistance in clarifying many details of its classification and distribution it is most appropriate that his name should be associated with this remarkable member of that family.

Cryptantha (§ OREOCARYA) **Hoffmannii**, sp. nov., biennis pungente hirsuta; caulibus erectis 1.5-3 dm. altis pluribus conspicue hirsutis minute retrorso-adpresseque hispidulis e radice palari orientibus; foliis basalibus rosulatis spathulatis 3-4 cm. longis 7-11 mm. latis firmis cinereis pustulatis hirsutis et hispidulis, pilis facierum superiorum adpressis, facierum inferiorum ascendentibus divaricatisve; foliis caulinis distantibus aliquantum viridioribus; inflorescentia thyrsoides usque ad 6 cm. crassa plus minusve interrupta; cymulis densis unilaterilibus scorpioidibus usque ad 4 cm. longis rariter dense glomeratis; lobis calycis anthesi 3-3.5 mm. longis tubo corollae aequilongis, fructiferis 5-7 mm. longis lanceolatis hirsutis hispidulis fulvescentibus; pedicellis 0.5-1 mm. longis rigidis

ascendentibus; corolla alba, tubo 3 mm. longo, limbo 5-6 mm. diametro; nuculis ovatis 2.5-3 mm. longis ca. 2 mm. latis apice acutis late tuberculatis et plus minusve rugosis, sulco infra medium nuculae aperto.

CALIFORNIA: rocky open slope, Westgard Pass, northern Inyo Co., 7300 ft., July 11, 1930, *Ralph Hoffmann* 78 (Gray Herb, TYPE).

Evidently related to *C. insolita* (Macbr.) Payson which is known only from a few collections made near Las Vegas, Nevada. It is distinguished from that species by its denser, much less elongate and rather open inflorescence, by the conspicuous, very abundant pungent bristles on its stems inflorescence and leaves, and by the lack of a white appressed tomentulous indument on the stem-base and lowermost leaves.

The species is named in honor of the late Ralph Hoffmann, until his very recent tragic death, Director of the Santa Barbara Museum of Natural History. Mr. Hoffmann was a most prolific and discriminating collector of the *Boraginaceae* during his many successful botanical trips about southern California. The collections which he shared with me have been extremely valuable in my studies of the difficult genus *Cryptantha*. It is my great privilege to associate his name with this large genus.

Lappula texana (Scheele) Britton, Mem. Torr. Bot. Cl. 5: 273 (1894). *Echinospermum texanum* Scheele, Linnaea 25: 260 (Feb. 1853). *L. Redowskii* var. *texana* Brand, in Engler, Pflanzenr. iv-252² (Heft 97):150 (1931). *E. Redowskii* var. *cupulatum* Gray, Bot. Calif. 1:530 (1876); Johnston, Contr. Gray Herb. 70:49-50 (1924). *L. cupulata* Rydberg, Bull. Torr. Bot. Cl. 28:31 (1901). *E. cupulatum* K. Schumann in Just, Bot. Jahresb. 29¹:564 (1903). *L. Redowskii* var. *cupulata* Jones, Bull. Univ. Montana 15:44 (1910). *E. scabrosum* Buckley, Proc. Acad. Philad. 1861:462 (1861). *L. heterosperma* Greene, Pittonia 4:94 (1899). *E. heterospermum* K. Schumann, l. c. 27¹:522 (1901). *L. texana* var. *heterosperma* Nelson & Macbride, Bot. Gaz. 61:41 (1916).—Northern Arizona and New Mexico, southwestern Colorado and western Montana and adjacent Idaho eastward to South Dakota, Texas and Coahuila.

Lappula texana var. ***coronata*** (Greene) Nelson & Macbride, Bot. Gaz. 61:41 (1916). *L. coronata* Greene, Pittonia 4:94 (1899). *L. heterosperma* var. *homosperma* Nelson, Bot. Gaz.

34:29 (1902). *L. texana* var. *homosperma* Nelson & Macbride, l. c. 41. *E. coronatum* K. Schumann in Just, Bot. Jahresb. 27¹:522 (1901).—Northeastern Colorado to Alberta and middle eastern Idaho, also in southern Arizona; frequently with the typical form.

A recent study of the American species of *Lappula* has convinced me that the really salient characters of *L. texana* have been quite ignored. *Lappula texana* is characterized by having the nutlet-margins, at least in three nutlets of each fruit, obese and strongly and completely inflated. The glochidiate appendages are short and terete and arise from the broad rounded summit of the thick upturned margin. The margin of the nutlets in *L. texana*, hence, is not so patently derived from the confluence of the marginal appendages as in *L. Redowskii* var. *desertorum*. Rather than appearing by their confluence to make the margin, the appendages seem seated upon it. In the variations of *L. Redowskii* the margin, even when broad, is never completely inflated, although the broadened bases of the appendages and the adjacent portions of the margin may be so.

The var. *coronata* is distinguished from typical *L. texana* by having the nutlets homomorphous. In the typical plant one nutlet in each fruit is strongly differentiated and similar to those of typical *L. Redowskii*. The other three nutlets in the fruit, however, are conspicuously margined in the manner I have described. The variety with homomorphous nutlets occurs in two well separated areas and has received a distinct name in each. I have, however, been unable to find characters to justify this. All through the genus *Lappula* and its allies there is a more or less clear tendency for heteromorphy in the nutlets. Although this is strongly developed in *L. texana* I see no cause for surprise or concern that a homomorphic form should arise independently at opposite ends of its range.

Lappula Redowskii (Hornem.) Greene, Pittonia 2:182 (1891). *Myosotis Redowskii* Hornemann, Hort. Hafn. 1:174 (1813). *Cynoglossum pilosum* of Nuttall, Gen. 1:114 (1818), not Ruiz & Pavon (1799). *L. Redowskii* var. *pilosum* MacMillan, Metasp. Minn. Valley 441 (1892). *L. pilosa* Hitchcock, Spr. Fl. Manhattan 30 (1894). *Cynoglossum Nuttallii* Sprengel, Syst. 1:566 (1825). *Pectocarya lateriflora* var. *Nut-*

tallii Brand, Pflanzenr. iv-252¹ (Heft 78):95 (1921), name only. *E. strictum* Nees in App. Neuwied, Reise 17 (1841), not Ledeb. (1829). *E. Redowskii* var. *strictum* Watson, Bot. King Exped. 247 (1871), name only. *E. Redowskii* var. *occidentale* Watson, l. c. 246, t. 23, fig. 9-10 (1871). *L. Redowskii* var. *occidentalis* Rydberg, Contr. U. S. Nat. Herb. 3:170 (1895). *L. occidentalis* Greene, Pittonia 4:97 (1899). *E. occidentale* K. Schumann in Just, Bot. Jahresb. 27¹:522 (1901). *E. pilosum* Buckley, Proc. Acad. Philad. 1861:462 (1861); Gray, Proc. Acad. Philad. 1862:165 (1862). *L. montana* Greene, Pittonia 4:96 (1899). *E. montanum* K. Schumann, l. c. 522 (1901). *L. calycosa* Rydberg, Bull. Torr. Bot. Cl. 28:30 (1901). *E. calycosum* K. Schumann, l. c. 29¹:564 (1903). *E. patagonicum* Spegazzini, Anal. Soc. Cient. Argent. 53:79 (1902). *L. patagonica* Macloskie, Rev. Fl. Patag. 214 (1915). *L. inconspicua* Brand in Fedde, Rep. Spec. Nov. 26:171 (1929).—From the east slope of the Sierras and Cascades eastward to the Dakotas and Texas, also in adjacent Canada; Eurasia; Argentine.

Lappula Redowskii* var. *desertorum (Greene), comb. nov. *L. desertorum* Greene, Pittonia 4:95 (1899). *Echinospermum desertorum* K. Schumann in Just, Bot. Jahresb. 27¹:522 (1901). *L. collina* Greene, l. c. 96 (1899). *E. collinum* K. Schumann, l. c. 522 (1901). *L. desertorum* var. *foliosa* Nelson, Bull. Torr. Bot. Cl. 27:267 (1900). *L. foliosa* Nelson, Man. Bot. Rocky Mt. 413 (1909). *L. cupulata* var. *foliosa* Nelson & Macbride, Bot. Gaz. 61:40 (1916). *L. texana* var. *foliosa* Johnston, Contr. Gray Herb. 70:51 (1924). *L. infelix* Greene, Pittonia 4:235 (1901). *L. columbiana* Nelson, Bot. Gaz. 34:28 (1902). *L. texana* var. *columbiana* Johnston, l. c. 50 (1924). *L. cucullata* Nelson, Bot. Gaz. 34:29 (1902). *L. leucotricha* Rydberg, Bull. Torr. Bot. Cl. 36:676 (1909). *L. cupulata* of Nelson & Macbride, l. c. 39, and other authors, cf. Johnston l. c. 50 (1924).—Southeastern Washington and southwestern Montana and Wyoming thence south through the intermontane area to southern California, Arizona and northern and western New Mexico. Also in Patagonia. Occurring with the species.

Lappula Redowskii is the most common member of its genus in the western United States. It is characterized by having the

glochidiate appendages (on all the nutlets in each fruit) in a single row and nearly or quite distinct. There has been a consistent attempt to distinguish the American plant from the Asiatic one. I am now of the opinion that this cannot be done and am consequently following Brand, *Pflanzenr. Heft* 97:146 (1931), in treating the American and Asiatic plants as inseparable. The binomial, hence, is here applied to the common form of the species in western United States generally called *L. occidentalis* or *L. Redowskii* var. *occidentalis*. The synonymy given above is complete only for the American plants.

In redefining *L. texana* and in laying emphasis, not exclusively upon the degree of development of its nutlet-margin but rather upon its obesity and complete inflation, it has become necessary to place elsewhere those common plants of the intermontane area of western United States which formerly were placed in *L. texana*. These plants have nutlet-margins that are conspicuous, but not obese and completely inflated. In all but a very few cases these intermontane plants are readily separated from *L. texana*. With *L. Redowskii*, however, they are connected by a host of intergrades. I am consequently treating them as a variety of that species. Extreme forms will be readily referred to the var. *desertorum* (as this intermontane plant is called), but much material will always remain which can be almost equally well placed in *L. Redowskii* or this variety, intergradation being so complete and transitional forms so common.

In the variety *desertorum* the marginal appendages of the nutlets are more or less completely united, their bases being more or less dilated and confluent. The free apical portions appear to be cuneate or triangular lobes of a thin or at most only partially inflated margin. In extreme forms the margin becomes quite cupulate. Though usually compressed and solid the lobes of the margin may be thickened and hollow at the base. In these characters the variety, especially in extreme states, is very different from *L. Redowskii* with its linear or strap-shaped, firm, quite distinct appendages. In *L. Redowskii* the nutlets are homomorphous. In the var. *desertorum*, though homomorphous forms are not uncommon, there is exhibited a pronounced tendency towards heteromorphy, one nutlet usu-

ally resembling those of *L. Redowskii* and the others in the fruit being more or less cupulate as described. In some forms of the variety the appendages are united on only one or two nutlets of each fruit and then not very conspicuously so. These forms represent transitions to *L. Redowskii*.

Lappula Fremontii (Torr.) Greene, Pittonia, 4:96 (1899); Nelson & Macbride, Bot. Gaz. 61:37 (1916); Johnston, Contr. Gray Herb. 70:48 (1924). *Echinospermum Fremontii* Torrey, Pacif. R. R. Rep. 12²:46 (1860). *L. erecta* Nelson, Bull. Torr. Bot. Cl. 27:268 (1900).

The original Fremont collection of this species from the Torrey Herbarium has been examined at the New York Botanical Garden. It bears in Torrey's hand "*Echinospermum Fremontii* sp. nov." The data read, "April 13th, 1844, Creek of the Pass in the Sierra Nevada, Fremont's 2nd Exped." The plant clearly belongs to the species *L. Fremontii* as that has been defined by Nelson & Macbride, l. c., and by me, l. c. The nutlets have appendages in more than a single row, well developed ones being produced on the side of the fruit. The pubescence is that of the Wyoming plant. As the species is definitely known only from Idaho, Utah and Wyoming north into Canada it is natural to doubt the correctness of the collection-locality given. It seems most unlikely that a plant of the plateaus along the northern Rocky Mountains could appear in the Tehachapi Mountains of California. As Fremont twice traversed Wyoming on his second expedition to California it seems much more believable that he obtained the type specimen in Wyoming and subsequently somehow mislabeled it.

Pectocarya linearis (R. & P.) DC. var. **ferocula**, var. nov., a varietate genuina differt nuculis homomorphis margine aliquanto minus armatis.

CALIFORNIA: on the ridge, San Nicholas Isl., 1000 ft., Trask (US); steep grassy slope, Lady Harbor, Santa Cruz Isl., April 10, 1930, Munz & Crow 11846 (Gray Herb, TYPE); Santa Cruz Isl., 1887, Ford (G); Santa Catalina Isl., 1902, Grant 913 (G); bare ridge near top of south wall of Bullrush Canyon, Santa Catalina Isl., 1000 ft., Fosberg 4779 (G); bare dry ridge at top of north wall of Hamilton Canyon, Santa Catalina Isl., 500 ft., Fosberg 4404 (G); grassy slope at Lemon Tank, San Clemente Isl., 1200 ft., Munz 6690 (G);

rare on arid cliffs, San Clemente Isl., 1903, *Traske* (US); San Buenaventura, Ventura Co., April 1887, *Parry* (ND); dry slope 2 mi. north of Saugus, Los Angeles Co., *Munz 10015* (Pomona); Inglewood, Los Angeles Co., April 1899, *Abrams 231* (Pomona); Pasadena, April 18, 1906, *Grant* (UC); gravelly field near Palmer Canyon, Claremont, Los Angeles Co., *Munz 2005* (Pomona); dry mesas near Upland, San Bernardino Co., *Parish 11155* (UC); in foothills of San Bernardino Mts., May 1, 1896, *Cummings* (G); Banning, Riverside Co., 2300 ft., May 11, 1903, *Jones* (Pomona); Reche Canyon, Riverside Co., May 1900, *Hall* (UC); San Jacinto, Riverside Co., 1700 ft., March 1898, *Leiberg 3111* in pt. (G); sand, Temescal Canyon, Riverside Co., 1200 ft., *Munz & Harwood 3387* (Pomona); dry open slopes 2 mi. east of Pala, San Diego Co., *Munz 10362* (Pomona); San Felipe Valley, San Diego Co., *Reed 6289* (Pomona); sandy field, Granite near San Diego, 1900 ft., *Spencer 115* (G); San Diego, *Jones 3052* (G). BAJA CALIFORNIA: Ensenada, April 13, 1882, *Jones* (Pomona); dry sandy slope 8 mi. southeast of Tecate, 2500 ft., *Munz 9479* (Pomona); 29 mi. southwest of Tia Juana, April 13, 1925, *Jones* (Pomona). CHILE: irrigated garden, Rio Laguna Grande east of Vallenar, Atacama, 2140 m., *Johnston 6283* (G). ARGENTINA: Frutilla, Prov. Mendoza, Oct. 1913, *Sanzin* (G); Mendoza, Oct. 1916, *Ruiz 40* (G); vicinity of General Roca, Rio Negro, 250-360 m., *Fischer 123* (G); San Antonio Oeste on road to Las Grutas, Rio Negro, Nov. 19, 1928, *Castellanos* (G); fields along Rio Negro, Nov. 19, 1904, *Berg* (G); frequent, Camarones, Chabut, 1912, *Aurelius* (G); mouth of Rio Chabut near Rawson, Nov. 9, 1895, *Dusén 5* (G); in fields near Rio Gallegos, Santa Cruz, March 11, 1882, *Spegazzini* (G).

This plant is the only representative of *P. linearis* in North America. It occurs in northern Baja California, in coastal southern California and on the islands off that coast. In South America it replaces *P. linearis* in Argentina, where it ranges at low altitudes from Mendoza southward for nearly the length of Patagonia. The single Chilean collection comes from north of the known range of true *P. linearis* and may have been introduced by pack-trains from over the Andean passes. The common *Pectocarya* of central Chile is typical *P. linearis*, the type of which came from Santiago. It appears to be endemic to that area. The margin of the nutlets are more conspicuous and evidently more coarsely toothed than in var. *ferocula*. There is a distinct though not conspicuous heteromorphy in its nutlets, one nutlet in each fruit having a somewhat broader wing than the others with this not so deeply lacerate into hair-like lobes at the apex as is common in most species. The nutlets of the var. *ferocula* have the margins well dissected and

have shorter less conspicuous teeth than the typical Chilean form. The nutlets are only very obscurely if at all heteromorphous. Though the differences recognized in this variety may seem weak I feel that the entity determined is a significant one and well worthy of recognition if for no more than phytogeographic reasons.

It may be noted here that the present variety covers the common *Pectocarya* of the islands off the California coast. This has been with great frequency misdetermined as *P. penicillata* (H. & A.) A. DC. That species seems, however, to be extremely rare on the islands if it is not quite absent. The only material I have seen from the islands which I feel might be referred to *P. penicillata* consists of some questionable collections made by George B. Grant on Santa Catalina.

Pectocarya recurvata, sp. nov., annua; caulibus gracilibus laxe ascendentibus vel prostratis 5-20 cm. longis strigulosis cinereis; foliis filiformi-linearibus vel anguste oblanceolato-linearibus 1-3 cm. longis 0.6-1.8 mm. latis strigulosis; floribus nullo modo cleistogamis; corolla breviter salviformi 2 mm. longa lobis ascendentibus; nuculis homomorphis linearibus reflexis distincte falcatis vel subscorpioideis 3 mm. longis 0.8 mm. latis lobos calycis superantibus margine dentibus numerosis armatis; dentibus solidis truncatis brevibus gracilibus conicis vel cylindraceis distinctis apice in pilum cavum elongatum uncinatum gradatim transmutatis; appendiculis marginis (i. e. dentibus pilis inclusis) subulatis pectinate dispositis quam latitudine nuculae longioribus.

CALIFORNIA: Darwin, Inyo Co., 4600 ft., April 28, 1897, *Jones* (Pomona); Surprise Canyon, Panamint Mts., Inyo Co., *Coville & Funston* 721 (G); Panamint Mts., *Hall & Chandler* 7045 (UC); hills of disintegrated rock on ridge near Garlic Springs, San Bernardino Co., 2700 ft., April 24, 1930, *Hoffmann* (G); Needles, San Bernardino Co., *Jones* 3811 (UC); Swarthout Canyon, San Bernardino Co., 6875 ft., *Hall* 1491 (UC); Coyote Canyon, Riverside Co., 500 ft., *Hall* 2845 (UC); near Indio, Riverside Co., Feb. 15, 1926, *Jones* (Pomona); dry slopes 5 mi. east of Jacumba, San Diego Co., *Munz* 8081a (Pomona). BAJA CALIFORNIA: San Esteban, April 17, 1889, *Brandegee* (UC); San Quentin Bay, *Palmer* 627 (UC); Guadalupe Island, *Anthony* 237 and *Palmer* 69a (G). NEVADA: Rhyolite, Nye Co., April 11, 1907, *Jones* (Pomona); among rocks, Erie, Clark Co., *Tidestrom* 8877 (US). ARIZONA: Fort Mohave, Mohave Co., April 1884, *Lemmon* (US); Congress Junction, Yavapai Co., 3000 ft.,

May 2, 1903, *Jones* (Pomona); Phoenix, Maricopa Co., Feb. 12, 1912, *Wooton* (US); near Chandler, Maricopa Co., March 26, 1930, *Harrison & Kearney* 6507 (Gray Herb., TYPE); Double Buttes 10 mi. east of Mesa, Maricopa Co., 1700 ft., *Gillespie* 5366 (G); near Oracle, Pinal Co., *Harrison & Kearney* 6658 (G); Picacho, Pinal Co., *Porter* 749 (G); between Casa Grande and Gila Bend, Pinal Co., *Harrison & Kearney* 6536 (G); San Tan Mts., Pinal Co., *Harrison & Kearney* 6463 (G); Tucson Mts., Pima Co., *Griffiths* 3496 (US); Benson, Cochise Co., April 1905, *Wilcox* (US). SONORA: Rio Aliso 6 mi. south of Cumetal, 1932, *Abrams* 13394 (Stanford).

This plant is related to *P. linearis* var. *ferocula* and appears to replace it entirely in the desert interior of southwestern United States. It is distinguished by its longer more slender nutlets which are very much recurved, in extreme forms becoming scorpioid, horseshoe-shaped or nearly coiled. The marginal appendages are somewhat better developed than in var. *ferocula*. The species occurs with *P. platycarpa* Munz & Johnston and with *P. penicillata* var. *heterocarpa* Johnston. Most material of it is found in herbaria misdetermined as *P. linearis*.

INDEX

Synonyms are printed in *italics*; new names in **bold-face** type.

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